PROCEEDINGS

of

THE FLORIDA STATE HORTICULTURAL SOCIETY *for*

1932

PUBLISHED BY THE SOCIETY

EDWARD SIMMONDS, Plantsman

For nearly a quarter of a century in charge of the Federal Plant Introduction Gardens of South Florida.

It seems fitting that Mr. Simmonds should go down into history with an avocado in his hand and standing under the first Guatemalan variety of the Wilson Popenoe Collection to fruit in this country—the Itzamna.

It was due to his alertness and plantsman's instincts that the Florida avocado growers have today the successful and promising Guatemalan - West Indian hybrid avocados with which they are building their new industry, for he saved the budwood when it came in and preserved some of the most important hybrids that originated from these varieties, introduced from various parts of the world.

He is shown demonstrating to Mrs. David Fairchild and Dorothy Crandall how a hard shelled McDonald avocado is eaten. Photo by E. L. Crandall, 1920. Courtesy of Division of Foreign Plant Introduction, U. S. Department of Agriculture.

PROCEEDINGS

OF THE

FORTY-FIFTH ANNUAL MEETING

OF THE

Florida State Horticultural Society

HELD AT

GAINESVILLE, FLORIDA
APRIL 19, 20 AND 21

1932

PUBLISHED BY THE SOCIETY
OFFICE OF PUBLICATION, DELAND, FLORIDA

Florida State Horticultural Society
Officers Elect for 1933

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N. A. REASONER, Oneco

EXECUTIVE COMMITTEE

PROF. W. L. DREW, Eagle Lake
H. HAROLD HUME, Glen St. Mary
FORREST D. BANNING, Miami

*Resigned.

Constitution

Article 1. This organization shall be known as the Florida State Horticultural Society, and its object shall be the advancement of Horticulture.

Article 2. Any person or firm may become an annual member of the Society by subscribing to the Constitution and paying two dollars. Any person or firm may become a perennial member of the Society by subscribing to the Constitution and paying the annual dues for five or more years in advance. Any person may become a life member of the Society by subscribing to the Constitution and paying twenty-five dollars. Any person or firm may become a patron of the Society by subscribing to the Constitution and paying one hundred dollars.

Article 3. Its officers shall consist of a President, three Vice-Presidents, Secretary, Treasurer, and Executive Committee of three, who shall be elected by ballot at each annual meeting. These officers shall take their positions immediately following their election.

Article 4. The regular annual meeting of this Society shall be held on the second Tuesday in April, except when otherwise ordered by the Executive Committee.

Article 5. The duties of the President, Vice-Presidents, Secretary and Treasurer shall be such as usually devolve on these officers. The President, Secretary and Treasurer shall be ex-officio members of the Executive Committee.

Article 6. The Executive Committee shall have authority to act for the Society between annual meetings.

Article 7. The Constitution may be amended by vote of two-thirds of the members present.

By-Laws

1. The Society year shall be co-extensive with the calendar year, and the annual dues of members shall be two dollars.

2. All bills authorized by the Society or its Executive Committee, for its legitimate expenses, shall be paid by the Secretary's draft on the Treasurer, O. K'd by the President.

3. The meetings of the Society shall be devoted only to Horticultural topics, from scientific and practical standpoints, and the presiding Officer shall rule out of order all motions, resolutions and discussions tending to commit the Society to partisan politics or mercantile ventures.

4. All patron and life membership dues and all donations, unless otherwise specified, shall be invested by the Treasurer in United States bonds. Only the interest in these bonds shall be available for payment of the current expenses of the Society. Perennial membership dues shall be placed on deposit at interest by the Treasurer. Only two dollars and the interest from each perennial membership fee shall be available for use in payment of the current expenses of the Society during any particular year.

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Hart, W. S., Hawks Park, Fla.
Hubbard, E. S., Federal Point, Fla.
Hume, H. Harold, Gainesville, Fla.
Lipsey, L. W., Blanton, Fla.
Rolfs, P. H., Vicosa, E. F. Leopoldina, Minas Geraes, Brazil.
Shaw, Miss Eleanor G., Gainesville, Fla.
Skinner, L. B., Dunedin, Fla.

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American Fruit Growers, Inc., Orlando, Fla.
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Armour Fertilizer Works, Jacksonville, Fla.
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Sampson, F. G., Boardman, Fla. (Deceased).
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Albertson Public Library, Orlando, Fla.
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Baltram, Francisco, Monterey, N. L., Mexico.
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Iowa State College Library, Ames, Iowa.
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Johnson, Sadie, Largo.
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Kirkland, J. G., care A. C. L. Railroad, Tampa.
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Krome, Mrs. Wm. J., Homestead.
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Lake Wales News, Lake Wales.
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Logan, J. H., County Agent, Bradenton.
Loomis, Burdett Jr., Pierce, Polk County.
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McCord, J. M., Palm Harbor.
McGuire, Dr. T. C., Plant City.
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McLaughlin Bros., Terra Ceia.
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McLeod, F. L., Babson Park.
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Mabson, H. B., care Lake Region Hotel Co., Winter Haven.
Madden, V. B., Eagle Lake.
Maher, W. J., Vero Beach.
Mallet-Brown Co., Frostproof.
Malone, T. E., Odessa.
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Mason, E. C., Lake Wales.
Matheson, Hugh M., 418 S.W. Second Ave., Miami.
Mathias, A. C., Lake Wales.
Matthews, Mrs. Robert M., Eagle Lake.
Maxey, Gregg, Sebring.
Maxey, L., Frostproof.
May, John F., Winter Haven.
Mayaca Corporation, Port Mayaca.
Mayo, Nathan, Tallahassee.
Melvin, C. T., care Gulf Fertilizer Co., Tampa.
Membry, J. G., Winter Haven.
Mercer, M. T., 3624 Royal Palm Avenue, Coconut Grove.
Merrill, G. B., Gainesville.
Merrin, Frank, Clearwater.
Merrin, George A., Plant City.
Merrin, P. A., Plant City.
Michael, A. B., Wabasso.
Miller, Ralph S., Box 491, Orlando.
Mims, C. W., Lake Wales.
Montgomery, Dr. J. H., Gainesville.
Morse, George A., Babson Park.
Morton, James C., Auburndale.
Moss Packing Co., Box 1407, Tampa.
Mouser, W. H. & Co., Orlando.
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Muller, Paul, Ft. Pierce.
Murray, Myron G., 5734 N. W. Third Ave., Miami.
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Nettles, W. T., Gainesville.
Newell, Dr. Wilmon, Gainesville.
Nickerson, H. Guy, Tower Lake Groves Co., Tampa.
Noble, C. V., Gainesville.
Nordman, Ferd, New Smyrna.
Norton, James S., Box 589, Lakeland.
O'Byrne, F. M., Lake Wales.
O'Kelly, E. B., care A. C. L. Railroad, Jacksonville.
O'Mara, Thomas F., Clearwater.
Oakley, George, Route 1, Box 59-G, Orlando.
Oglesby, R. M., Bartow.
Orlando Citrus Growers Ass'n., Box 1996, Orlando.
Overcash, W. C., Dunedin.
Palm Harbor Citrus Growers' Ass'n., Palm Harbor.
Palmer, H. W., Fruitland Park.
Palmer, J. C., Windermere.
Pardee, S. Colquitt, Avon Park.
Parrish, C. A., 301 E. Poinsettia Drive, Lakeland.
Peacock, A. J., Plant City.
Pearce, Eugene L., Clearwater.
Pederson, W. C., Waverly.
Peninsular Distributing Co., 705 Telephone Bldg., Tampa.
Pennock, Herbert A., Box 118, Jupiter.
Pepper Printing Co., Gainesville.
Pickard, A. F., Lakeland.
Pinkerton, C. M., Howey.
Polk County Citrus Sub-Exchange, Bartow.
Poole, S. F., Lake Alfred.
Portens, Thomas, Route 2, Box 334, Tampa.
Pratt, A. M., Winter Haven.
Pratt, J. C., Babson Park.
Prentice, James, Coconut Grove.
Preston, Miss Mosel, Bartow.
Price, Charles A., 5203 Seminole Ave., Tampa.
Price, Mitchell D., Box 3190, Miami.
Princess Groves, Inc., Lake Wales.
Prine, R. H., Box 85, Terra Ceia.
Pruden, Alfred, Lake Heart Grove, Winter Haven.
Quaintance, W. D., Lake Wales.
Rancho Margarita, Box 418, Sebring.
Raney, George P. Sr., 905 S. Rome Ave., Tampa.
Ray, Alexander, City Hall, Jacksonville.
Reck, W. M., Avon Park.
Register, Don, Winter Haven.
Reiff, Chas. O., Marianna.
Remy, H. M., Box 1475, Miami.
Rhoads, Dr. A. S., Cocoa.
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Rinaldi, W. T., Lake Wales.
Roberts, A., Dade City.
Robins, Mrs. Raymond, Chinsegut Hill, Brooksville.
Robinson, T. Ralph, Terra Ceia.
Rogers, H. S., Winter Haven.
Rue, Frank B., Homestead.
Ruehle, Dr. G. D., Lake Alfred.
Ruff, Dr. J. F., Clearwater.
Rundle, F. A., Lockhart.
Ruprecht, Dr. R. W., Gainesville.
Saunders, C. F., Sebring.
Saurman, A. B., Box 848, Clearwater.
Schnarr, J. & Co., Orlando.
Schneider, Albert, Plant City.
Schutzman, Samuel, Eagle Lake.
Scott, J. Bernard, Winter Haven.
Scott, L. W., High Fields Plantation, Tallahassee.

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Scott, W. M., Box 892, Orlando.
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Seminole Lodge Co., Lake Wales.
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Simpson, C. A., Monticello.
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Skinner, Mrs. L. B., Dunedin.
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Sloan, D. H. Jr., Lakeland.
Sloan, G. D., care Gulf Fertilizer Co., Tampa.
Smith, Cleve F., Largo.
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Smith, R. N., Dundee.
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Speese, George, 116 Maxwell Dr., Lakeland.
Spencer, A. P., Gainesville.
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Stevenson, G. A., Deerfield.
Stewart, L. D., Sebring.
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Stott, Alec F., Clearwater.
Stuart Bros. Corp., Bartow.
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Swanson, A. L., Tavares.
Synthetic Nitrogen Products Corp., Box 417, Plant City.
Tampa Morning Tribune, The, Box 21, Tampa.
Taylor, Mrs. John S., Largo.
Taylor, Margaret E., Ocala.
Telford, C. W., Lake Alfred.
Terwillinger, A. C., Titusville.
Thomas, Clara I., Box 3204, St. Petersburg.
Thomas, Wayne, Seffner.
Thompson, C. H., Winter Haven.
Thompson, W. L., Lake Alfred.
Tillinghast, B. F., Crescent City.
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Van Clief, W. C., Winter Haven.
Varn, W. A., Lake Wales.
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Vissering, Norman H., Babson Park.
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Waldron, Max, Babson Park.
Waldrop, J. P., Winter Haven.
Walker, Eli C., Vero Beach.
Walker, Marvin, care Florida Grower, Tampa.
Ward's Nursery, Avon Park.
Warren, Alfred, Ft. Pierce.
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Winter Haven Planing Mills, Winter Haven.
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Woods, V. E., Davenport.
Woodson, Henry P., Clearwater.
Wooten, S. F., Box 346, Tampa.
Wray, F. L., Hollywood.
Wright, Mrs. Kate, Orlando.
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Ziegler, L. W., Box 1297, Orlando.

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Brooks, J. R., Homestead.
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Cowles, H. T., Mayaguez, Porto Rico.
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Mead, Theodore L., Oviedo, Fla.
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McCormick, Holland, Ft. Myers, Fla.
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Sexton, W. E., Vero Beach.
Shippy, Dr. W. B., Leesburg, Fla.
Skinner, F. L., Dunedin, Fla.
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Stambaugh, Scott U., Hort. in charge Adams Exp. Station, Harlingen, Texas.
Taber, George L., Jr., Glen St. Mary, Fla.
Taber, Mrs. Mildred U. (Geo. L.), Glen St. Mary, Fla.
Taylor, Chas. H., Walton, Fla.
Tobacco By-Products & Chemical Corp., 1004-14 Columbia Bldg., 4th & Main Sts., Louisville, Kentucky.
Upton, Mrs. Frank M., Ft. Pierce, Fla.
Vickers, E. W., Sebastian, Fla.
Winter Garden Ornamental Nurseries, Winter Garden.

PROCEEDINGS
OF THE
FLORIDA
STATE HORTICULTURAL SOCIETY

VOL. XLV PRINTED 1932

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Forty-fifth Annual Meeting of the Florida State Horticultural Society

The Florida State Horticultural Society goes to school! Holding its Forty-Fifth Annual Session in Gainesville, April 19, 20 and 21, 1932, with headquarters at the Hotel Thomas and meeting in the auditorium of the University of Florida, it found opportunity to meet with the members of the faculty, the research men of the Agricultural Experiment Station, the students and the citizens of Gainesville on their own home grounds, and the visit was a pleasant and a profitable one. The members were shown every nook and cranny of the institution, told of its organization and were royally entertained during their spare moments. Among the various entertainments provided were an afternoon reception for the members given by the University in the corridors of the Florida State Museum and a reception by Mrs. M. M. Parrish and members of the Gainesville Garden Club in honor of Mrs. Chas. W. Ten Eyck, President of Florida Federation of Garden Clubs, to which the ladies of the Horticultural Society were invited. Mrs. Parrish's home was made into a bower of flowers and ornamental plants arranged with a taste and artistry that is seldom equaled and was well worth seeing.

Rose Show

The Seventh Annual Florida State Rose Show was held under the auspices of the Horticultural Society and the Florida Rose Society and under the direction of Prof. W. L. Floyd and Mr. J. V. Watkins. A very creditable display of roses was made in spite of the severe handicap of unseasonable weather and lateness of the season that made material scarce.

Tung Groves

Years ago Gainesville was the center of the citrus region in Florida. Today it is the center of Tung Oil production in the State. The members were shown extensive plantings of Tung trees around Gainesville under the leadership of Messrs. B. F. Williamson and H. W. Bennett. While the growing of Tung trees and the production of nuts and oil have their problems which were discussed on the program, the industry is getting a good start in the Gainesville section and promises to be one of the important industries in the state in a short time.

Florida Rose Society

The Seventh Annual meeting of the Florida Rose Society was held on the afternoon of April 19th in Peabody Hall of the University of Florida. An interesting and excellent program was carried out under the leadership of its president, Mrs. S. F. Poole of Winter Haven. There is a growing interest in the work of the Rose Society and it is anticipated that in time the membership and interest will be sufficiently great to justify a separate meeting at a time more in keeping with the peak of rose bloom in the state. The lateness of the meeting of the Horticultural Society is a handicap for the Florida State Rose Show.

Ornamental Program

The part of the Horticultural Society program devoted to the discussion of ornamentals was carried out in a session separate from that of the regular program of the Society. This session was held in Peabody Hall on Wednesday

morning, April 19th, in co-operation with the Gainesville Garden Club. Mr. H. Harold Hume served as chairman of the section. Among the prominent speakers were Mrs. Chas. W. Ten Eyck, president of the Florida Federation of Garden Clubs, and Mrs. B. V. Christensen, president of the Gainesville Garden Club. Mrs. Ten Eyck's talk is printed in full in these Proceedings. Unfortunately a number of the talks before this section were not obtainable for publication.

Forty-Sixth Annual Meeting of the Society

The Forty-Sixth Annual meeting of the Society is to be held in Lake Wales at a date in 1933 to be decided by the Executive Committee of the Society. It will probably be held in early April.

PROCEEDINGS

OF THE

Florida State Horticultural Society

FORTY-FIFTH ANNUAL MEETING

GAINESVILLE, APRIL 19, 20 AND 21

OPENING SESSION

Pres. John S. Taylor, Largo: This is the Forty-Fifth Annual Session of the Florida State Horticultural Society. We will now come to order. Dean Talbert of the University of Florida, will deliver the invocation.

Invocation delivered by Dean Talbert

Pres. Taylor: The Mayor not being able to be present, Dean Talbert will deliver the address of welcome.

ADDRESS OF WELCOME

Dean Talbert, Gainesville

This is indeed a surprise to me, but rather a welcome duty that I have now, wished on me. As a matter of fact, I am not a member of the State Horticultural Society; I am not even a member of the Department of Agriculture of the University of Florida, but I am a very enthusiastic member of the University.

We are indeed glad to have you with us, because we believe that the better you know the University the better you will like it; we believe the better you know the students of the University the better you will like them, even though they do at times about like your boys at home. As a matter of fact, we believe that you will be pleased with the students we have here, and we now consider it an honor that you have come to the University for this meeting. In arranging the program of entertainment we have tried to side-track everything that might possibly conflict with your pleasure while you are here, and we have attempted to put on the main line everything that would add to your pleasure while you are here. If Dean Newell and the Department of Agriculture can't furnish you everything

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that you think you need, if you will call on the office of the Dean of Students we will get the boys themselves to give you a royal welcome. Don't ask for too much hilarity, because you can't stop them, but we are glad to have you with us, and we feel the University is indeed honored in having you here.

Again, I say, if there is anything that we can do, if you will call on us, we will be very glad indeed to co-operate with you in every way possible in making your stay with us happy and successful.

RESPONSE TO THE ADDRESS OF WELCOME

S. F. Poole, Winter Haven

You really have my sympathy. This must be the fifth or sixth time, maybe the 'nth time that I have appeared before you in this capacity. Apparently the only way you can get rid of me is for me to tell the nominating committee not to put me on again as Vice-President. But in more ways than one you are to be pitied. Now I suppose that in this University city, where there is so much in the way of education and science entered into, in this little hamlet it behooves ourselves to be absolutely precise in our language. If a certain event happens once I think physics says it is a phenomena; but if it happens twice it is a coincidence; and if it happens three times it's a habit; but if it happens five or six times it's just too bad for you, that's all.

Of course, we are glad to be here. We always make the most of an opportunity to come to this town and to this University. Now the Dean has made a very large promise to us. He says "If there is anything you want, why just let us know." Well, of course, I am afraid some of our members will take it for granted that they can go ahead and get it anyway, whether they go to the Dean or some other official or not; they will just go and get it themselves, isn't that right, Dean?

(Dean Talbert: Leave it to the boys; they will get it for you.)

All right. Now I will tell you one on our Secretary. He has been working rather hard, and has been very anxious to get in memberships during the past year. They are telling this story about him: That a certain colored preacher was trying very hard to get some money out of his congregation, and was not getting a very good collection. One night when he was preaching he said, "This church am going walking," and they all said "Amen"; he said, "This church am going running," and they all said, "Amen, let her run"; he said "This church am going to fly," and they all said, "Amen, let her fly"; he says, "But Brethren, this church am going to fly or pay off," and they said, "Amen, let her walk."

But we really are in a very receptive mood at this time, as we have already indicated. We are here; it's always a pleasure to be in this town and in this community, and we are going to make the most of it, even to taking what we find loose. We sometimes may be tied down to the sign "Do not trespass, or do not molest," but when we see those signs, we are like the boys around here—we want to investigate, and if you will leave it to me I will say that all of us who are present here tonight, and others, too, are going to make the most of our opportunity; we are glad we are here, and we hope that you will enjoy our stay just as much as we will. Thank you.

Pres. Taylor: With all of the difficulties that we have, we would have been glad to have seen this auditorium at least half full of people this evening, but for my part I would rather see that rain we have had than to see this auditorium

filled with people, and I believe we all feel that way about it.

As you all know they have put on the program the President's Annual Address, and I see they have printed that, in the years back, so I have decided this time I would put what I have to say on paper, and if you will pardon me I will read largely what I have.

PRESIDENT'S ANNUAL ADDRESS

John S. Taylor, Largo

I am proud of this Society, now in its forty-fifty year of useful life. It seems to me that as time goes on there is more need for an organization like ours than there could have been at the time of its inception, because it has so much to do with the development of the many varieties of semi-tropical and tropical fruits, the growth and development of which means so much to many of us.

Why has this Society lived to be forty-five years old? It is the result of co-operation among its members, an intelligent body of men and women, who have given unsparingly of their time and energy to make it a success. I feel sure that it will continue to live, and as time goes on it will grow in usefulness because of the greater necessity for it.

I think it is a generally accepted fact that a new or undeveloped country is not troubled to so great an extent with the insect pests and diseases, that seriously interfere with the growth and development of agricultural crops. But, as time goes an, this army of pests becomes greater and they must be controlled. Consequently, there is great need for the growth and influence of our Society, that we being banded together, may through co-operation, be able to resist our common enemies — insects and diseases — which in ever-increasing numbers, so sorely hinder the growth and development of the plant life, that we, as well as future generations, must depend on for our existence. Therefore let me urge each and every member to be more diligent in their efforts to build our Society in numbers as well as in influence, and to see that it does not go backward but goes forward into a sphere of greater usefulness. We can accomplish much by going forward, but nothing by standing still. We must go forward, notwithstanding the fact that it sometimes seems that the difficulties that confront us are almost insurmountable. But they are not. It only calls for more courage and determination, and knowing the spirit of our American men and women, I can say with confidence, that we will go forward with determination and confidence in our ability to win. And we *will* win.

I am proud to be an American and doubly so to be a citizen of Florida — the most wonderful of all the forty-eight states. I am proud of the citizenship that Florida possesses. When her people undertake to do a thing, they do it. Among the notable instances of their courage and determination, without thought of failure, I might mention the eradication of the bacterial disease, citrus canker, a feat that has never been accomplished elsewhere in the world, so I am informed. And then the much more serious menace — Mediterranean Fruit Fly. Thanks to our Federal Department of Agriculture, in co-operation with our State Plant Board, these most disastrous pests have been brought under complete control. Some of us have courage to believe that these, the most dangerous of all pests and diseases, have been completely eradicated. May I ask here, how these seemingly impossible tasks were accomplished? My answer is—through co-operation. May I not then urge our Society and the citizenship of Florida as a whole, to for-

get self and selfish interests, and fall in line all together for the good of all.

Doing this, we as a state will soon emerge from the terrible feeling of depression, that has so completely enthralled the most of us for too long a time. I say, let us awaken ourselves, throw off this lethargy, and go forward to do greater and better things. Be an example for progress for other states, and not a stumbling block. The people of Florida can, through co-operation, do anything — everything they undertake — but little, if anything, without it.

Then, why should not we as a Society, adopt a real program for the betterment of conditions that affect some of our most important industries — the growing of fruit as well as the almost unlimited number of ornamentals and many other money crops, that can be successfully grown in Florida? There is no state in the Union where the generous and intelligent planting of ornamentals about the homes, in parks, and along the highways, can be done, and the returns be greater for the time and money expended, than in this great state of ours.

We need more educational work along these lines, and I know of no better medium than through our Society, working in co-operation with the Extension Division of our State University and College for Women, and through our high schools throughout Florida.

THE UNIVERSITY OF FLORIDA

Jno. J. Tigert, President of the University of Florida, Gainesville

The President of the Society apologized for reading a paper. I realize that in an organization of this kind, which is scientific in its nature, that a man ought to be brief and exact in what he has to say, and I am sure that all the speakers, up to this time, have been, and for your comfort I will say that there is no one following me. Judge Holland was unable to be here this evening, and I am left to administer the rest of the punishment.

I am supposed to say something tonight by way of welcome from the University community and I was advised by Dean Newell that I might interpret to you the work and program of the University. It would be very difficult, even in one evening, to give you a real conception of the University of Florida; if I succeeded in giving you an idea of the duties of the President I would do very well. I travel about the state, and people say, "You are the Professor over here at Gainesville"; some say "That's the Superintendent of the College at Gainesville."

The administrative officer today is expected to do a great many things. He is supposed to induce wealthy people to make great benefactions, so buildings may rise and departments may be endowed and work carried on. At the same time he is supposed to be on the job buttoning up around the whole establishment and developing a good morale in the organization, and if there is a speech to be made on Horticulture, or on Hebrew History, or on Geology or Ichthyology, or horse racing, or football, or something else, he is supposed to be able to rise at any time and offer the piece de resistance on that particular subject. If at any moment some student has a mishap, the President is supposed to know all about it. Sometimes people call me at two or three o'clock in the morning, and say, "Doctor, I wish you would send John home, his mother is sick." I say, "John who?" They say, "John Smith, you know him." If something happens in a department of the faculty, the President is immediately expected to get the thing straightened out and patched up. Those are just some of the things that come up from time to time.

Dean Newell told me to give you some idea about the work of the University, and I shall do

that as quickly as I can, and let you go back to your respective places of rest. Some people refer to us as the "College." We have seven complete colleges, and two colleges that are in the process of formation. We have a College of Arts and Sciences, which is really the backbone of the institution, and ought to be the backbone of any institution of this kind. It happens to be the college of the largest enrollment, with six or seven hundred students. The reason I say a college like that is the backbone of a University of this type is because it serves not only as the basis for a liberal and scientific education, offering an acquaintance with broad and liberal subjects, but it is also the basis of all professional training.

Most technical and professional schools require a preliminary course of two years of general education. Others require four years. All great medical colleges require four years pre-professional training. We recently decided to have a pre-professional requirement of four years for our law school, and it is the only law school in the Southern States which has adopted an entrance requirement that high.

We do not have a medical or dental school, but we have more students taking pre-medical and pre-dental work than are enrolled in the courses leading to Bachelor of Science and Bachelor of Arts degrees.

Somewhat akin to the College of Arts and Sciences is the College of Chemistry and Pharmacy, and we have such good morale in the organization here, and such frankness of expression among the faculty that I can even make statements like this, without fear of arousing jealousy — that we have no college on the campus that stands higher perhaps than the College of Pharmacy and Chemistry. It is more developed than the University as a whole. I have come to the conclusion that it is a very good thing to have a college on the campus of the University which has national distinction, because in a university like this, which is a combined State University and land grant college, with all the professional schools, except medicine and dentistry, and competing with the State Universities in the North, which have a great deal more money, if the University is to attain any distinction beyond the borders of the State of Florida, it must do so as a man does in the practice of law or medicine today when he gains distinction, viz., become an expert in some particular type of operation, or some particular field, or subject, as the case may be. You can't today be a general practitioner and practice in all the various fields of medicine and have an outstanding place.

The man today known across the continent is the man who applies his time and attention to one type of operation. A lawyer becomes famous as handling one particular type of case, as for instance, Clarence Darrow, who has become famous in defending certain types of criminals.

The University has on its campus a college which is as strong as any college of that type in any of the great Universities. We have men who have made contributions in research, who have published works that have gained national recognition, and it is not infrequent that the men in the faculty hold from one-half to one-third of the offices in the national organizations in which they participate, and that is a thing to be proud of. That happens to be the only faculty on the campus sufficiently trained and strong, in which we can offer the Ph. D. degree, which we offered for the first time a year or so ago. We have on our campus this year a Dean from the University of Montana who came here in order that he might pursue his doctorate in our College of Chemistry and Pharmacy.

You people know a great deal more about the College of Agriculture than any other college on the campus. I have said many times that there is no college on the campus which is as important as the College of Agriculture, in my judgment. I will not take time to dwell on it at great length. I know that in the various meetings you have had and are going to have that you will come in contact with Dean Newell and his efficient staff. I think that Florida is going to remain very largely an agricultural state. There is nothing more important by way of service for the institution to render than along the line of Agriculture. Florida is one of the

four states, if I am correctly informed, which relatively has maintained its rural population through the last decade or so. You are aware of the fact that in 1910 the population of the United States was something like sixty per cent or sixty-five per cent rural, that is to say, considerably more than one-half of the population lived in the open country or in towns of 2500 or less. By the census of 1920 the population was about equally divided as between the rural and urban elements, but the last census revealed a great migration, and our population now is overwhelmingly urban. Florida and three other states have maintained their same rural population through this drift of the people from the rural sections to the cities.

Florida is practically untouched, so far as the cultivation of its lands are concerned. It is a vast empire. It has very peculiar problems because of the nature of its soil, climate, rainfall, lack of frost and many other conditions, distinct and different even from California, the entire state lying south of the most southern part of California. Florida lies in a sub-tropical climate, different from any other state in the United States, under conditions that require special study of the soil, fertilizers and other things. I believe Florida will remain an agricultural state as long as industries and power are developed as they are today. Of course, if the time comes, such as Mr. Edison described shortly before his death, when we will take nitrogen directly out of the air we will burn the coal in the mines and transmute it into electrical energy, or if we discover a process whereby we can convert the sun's rays into power directly, and harness the waves of the seas, as we have harnessed the falls and rivers in mountainous countries, conditions will change. When the sea and the sun can be harnessed, Florida will be on the map, but unless that time comes it is not my impression that Florida will become an industrial state. We are too far from the markets; we have very few raw materials; raw materials will have to be brought here. Power is now brought here from distant points and the future of Florida lies in the development of its lands. This latter is tied up with the solution of such problems as proper grazing, and a successful war not only upon the pests which have been exterminated, but others that constantly come. Almost every day I discover a new kind of bug or parasite that can prey upon an innocent man!

We are constantly facing these situations, and in our Agricultural Experiment Station we have developed an exceptionally strong staff. Its development has been the work of Dr. Murphree, and more particularly of Dean Newell. The Experiment Station staff is doing a tremendous piece of work under very great difficulties. If there ever was a building completely used, and which is entirely inadequate for its purpose, it is our Experiment Station building. They tried to build a building of four stories with $40,000. The station staff, to my mind, is doing a very outstanding piece of work and some of the departments over there are entitled to national recognition.

In the field of Plant Pathology, for special reasons, we have a staff that is equalled, or surpassed, if at all, only at Cornell University and the University of California.

The College of Engineering has been developed by a man who was probably the best trained man on this campus. He spent twenty-five years here in building up the Engineering College. The late Dean Benton of the Engineering College was a Ph. D from Leipsig, did graduate work at Cornell, and was an author of national distinction.

I am the last one that knows of the things happening around here. They bring me the roses. Even the last freshman on the campus may know all about things that I have not heard. I may be fooled, but the students are not often fooled, even the freshmen. I think about nine out of ten students will tell you that the College of Engineering is the place to stay out of. if you want to dance and play football and other things, and not work too hard. I do not feel competent, in a technical way, to interpret the College of Engineering to you, but I am certain that it is maintaining exceedingly high standards of work.

We have another professional school, our College of Education. It was formerly the Teachers' College, but we now call it the College of

Education. The Buckman Act gave us the most progressive and only thing of its kind that has ever happened in the history of American education. It abolished some half dozen or more struggling institutions of higher learning supported by the state, relieved their faculties, confiscated their properties, and then established two new institutions. We have the germs of something like that now happening in other places; for instance, Georgia. They have been multiplying institutions of learning and now find themselves with twenty-six Universities and Colleges in Georgia. One statesman who has more wisdom than finesse said that the trouble with Georgia was that the State Colleges and Universities were like a sow with a lot of pigs — the sow is being sucked to death, and the pigs are all starving. There are five Colleges of Agriculture. In the City of Athens there are three institutions of higher learning, the University of Georgia, the College of Agriculture, and a Teachers College, all adjacent to each other, all under different Presidents and, until recently, under different boards. The last legislature in Georgia abolished and merged more than a hundred different departments, commissions and boards into something like nineteen or twenty. They abolished all the boards of their twenty-six institutions of higher learning, and set up a single board.

North Carolina is consolidating its three state institutions of higher learning under one administration, eliminating useless reduplication and hoping to promote efficiency. Florida did all that twenty-five years ago. This brought about a consolidation and concentration of education in Florida that doesn't exist anywhere today except in Wyoming. In Florida we have only four institutions of higher learning, with one Board of five members appointed by the Governor, which is practically an executive committee. Colleges of Education, including courses in teacher training, are parts of the University and the Woman's College at Tallahassee. There is no other school or college in the state that is supported by state funds for the training of teachers. In other words, instead of having thirteen separate teachers' colleges and normal schools, as in Massachusetts, and six or eight as in Michigan, and five or six as in Missouri, Florida has integrated the colleges of education with the University and Women's College. We have no separate teacher training institutions competing for state funds with the University and Women's College. A great obligation rests on the University and on the Women's College to establish adequate research work in education, in a way comparable to the research program being carried on in the Agricultural Experiment Station, that will serve the schools of the state as the Agriccultural Experiment Station serves the agricultural interests of the state. Under our College of Education we hope we may have within a year or two the most complete demonstration school in the Southern States. Such a program will attack the problems of education and attempt to foster and aid the public schools in the state rather than going on in the hit-and-miss fashion that we have been employing in public education.

Born in an educational institution, and in educational work all my life, and for some eight years ahead of the public school system of the United States, and during that time traveling in all the states, visiting schools, I became deeply interested in the program of public education, which is the biggest business this country, or any other country, has. Each of us has a solution to the various difficulties confronting us, but as I see it, the American people must either make a success of public education, or disfranchise all the ignorant people. If the ignorant masses must solve the problems facing the American people today, we are bound to go down in chaos.

We must limit the right of suffrage to those who are literate and who possess a reasonable degree of education, or make our school system function more generally and more effectively. Dr. Frank E. Spaulding, Director of the School of Education at Yale University, stated in 1916, that the average American had a fifth grade education. By this time we are probably a nation of seventh graders. We have thirty million children of school age. There are twenty-one million in the high schools and elementary schools of the country and one million in the colleges and universities. Although every state has a compulsory education law which is intended to

require every child to have the fundamentals or equivalent of an elementary school education, this law is of little or no effect in some of the states. I regret to acknowledge that in some of the southern states the compulsory education law is no more effective than prohibition in New York.

If millions continue to grow up in this country in ignorance and exercise the right of suffrage the outcome can only resolve into supreme catastrophe. President Roosevelt expressed the opinion at one time, that we could dispense with our transportation system or our industrial system and still survive, but if our schools were closed for one generation our government would be essentially destroyed. Others have given expression to the same thought in different words. Edmond Burke once said that an educated citizenship is a greater protection to a nation than a vast standing army. There is nothing more important for our nation and for our state than the development of organized research in the field of education to the end that we may train a citizenship capable of discharging the duties and responsibilities necessary to the success of a representative republican form of government such as we have.

Our College of Law has already been mentioned. For some time it has been graduating more lawyers than the profession could readily absorb in Florida. Accordingly we felt that we were justified in raising the standards of admission. By requiring a pre-professional training of four years we have made our Law College comparable with the strongest colleges of law in other parts of the country. Our law graduates will have a fine foundation of general education, as well as complete technical mastery in the field of law. Lifting the standards may reduce the output but this will do no harm as we are turning out a superfluity at present.

Our College of Commerce and Journalism is only five years old. It has grown beyond all expectation. It reminds me of the way things grow down in the 'Glades. They plant celery today and eat it tomorrow. Palm trees planted at our station at Belle Glade after the hurricane in 1928 look today to be ten years old. Our College of Commerce and Jorunalism, without a home, has grown in five years to the next largest college on the campus in point of numbers. It has an enrollment of nearly seven hundred. In order to provide recitation rooms for this rapidly expanding group of students we have found it necessary to eject the students from a portion of our dormitories, remodel rooms, and use them for lectures and recitations.

The College of Commerce has a great opportunity for service. Its relation to business and industry in the state should be similar to the relation of the College of Agriculture to the farming, livestock, and other agricultural interests. There is an urgent need for research in this field. The Dean of the College of Commerce and Journalism is young and aggressive. He plans to develop a Bureau of Economic Research as rapidly as we are able to furnish the means. There are a great many economic problems which are confronting the people of our state which we are attempting to solve by hit-and-miss methods or through purely political machinery. We need adequate data and scientific information on such questions as taxation before intelligent legislation can be effected.

In addition to the colleges we have two "schools"— the Graduate School and the School of Architecture. No University really deserves the name until it is training its students in advanced branches of knowledge and at the same time extending the sum total of knowledge in some directions. Two years ago the legislature of Florida authorized the establishment of a Graduate School at the University of Florida and made a small appropriation so that a minimum of books and materials might be secured. I am glad to say that in the short time in which it has existed the Graduate School at the University has grown rapidly. The number of students taking the Master's degree increases appreciably each year. We are offering the Doctor of Philosophy only in one department of the University as yet. We hope to offer this degree in other lines in the next year or two. Outside of the College of Chemistry and Pharmacy we do not

have the facilities or the equipment to offer the doctorate.

I have had the thought that research and graduate work could be tied up more effectively than has been the case in our University. If the members of our staff who engage in research should have the opportunity of making use of graduate students it would seem to me that a double purpose could be served. The research work could be expedited with an attendant reduction of drudgery and our graduate students would get a more useful form of training.

We have arranged to bring Dr. Arthur J Klein to the University of Florida next year Dr. Klein is now permanently connected with the Ohio State University, but has been recently engaged in assisting with the organization of the graduate and research work at the University of Chicago.

The School of Architecture is the beginning of what we expect to become a College of Fine Arts. At present the school is under a Director who is also the Architect to the Board of Control. The School has been doing exceptionally good work in the field of architecture. It has been growing rapidly and some of its graduates are already making a practical success. In view of the great collection of paintings which Mr. Ringling has brought to Sarasota it would be unwise for the University to attempt to collect pictures. The State could never hope to provide facilities here comparable to those at Sarasota. Mr. Ringling has told me that all the facilities of his museum will be extended to students in the University without any cost whatsoever. By providing transportation to Sarasota our students can enjoy the same benefits from the Ringling collection that students in the Ringling Art School enjoy. Under these conditions there should be liberal opportunity of developing a School of Fine Arts at the University, adding sculpture and painting to the effective work which is already being done in architecture.

In this review I have made no attempt to discuss the activities of numerous offices and departments which are related to the administrative machinery or perform general service in the University. No attempt has been made to mention the work of the registrar's office, the business office or the office of the Dean of Students. We have made no mention of the departments in which athletics and the military work of the University are performed. Nothing has been said concerning the operation of the dormitories, the cafeteria, the infirmary and similar services.

Before concluding, some mention might be made of the radio station and museum. The radio station is the one high powered radio station in the State, and was established by the legislature without recommendation by the Board of Control. The Board of Control has placed the responsibililty of operating the station upon the President of the University of Florida. The establishment of the station involved competition with municipal and commercial broadcasting stations. It is exceedingly difficult to operate a station of this kind without considerable dissatisfaction. There are those who think that such a station should support itself through commercial advertising without assistance from the state treasury. There are others who are equally insistent that such a station should receive no commercial advertising and thus compete with commercial stations and other advertising mediums. The present policy of WRUF is to accept advertising where we are solicited to do so and when we believe such advertising is not prejudicial to the public interest. The station does not solicit advertising and rejects a great deal which would seem to be unwise. The first wave length assigned the station proved to be exceedingly unsatisfactory. and was changed after a hearing had been granted by the Federal Radio Commission. Coverage at the present time reaches into Canada, west of the Mississippi River, and into Central America.

The museum at the University is one of the most neglected of our interests. Florida has exceedingly abundant scientific remains. Dr. Henry Fairfield Osborn, Director of the New York Museum of Natural History, states that scientific remains are greater in Florida than in any other state. Whether this be true or not, probably no state has done so little as Florida in collecting and preserving these valuable materials.

Northern museums and universities have actively engaged in excavating and carrying remains from Florida for many years. The State of Florida has done practically nothing. Our museum has a collection which includes practically all the birds and reptiles of the state, and much other material of value and vital interest. At present we are able to exhibit about fifteen or twenty per cent of the collection. The building is a fire hazard and the collection, which is valued at $250,000.00, is likely to be destroyed by fire at any time. It is not probable that the State of Florida will become sufficiently interested to erect an adequate building for the museum at any time in the near future. Efforts are being made to secure assistance from other directions. Recently a collection of birds and butterflies valued at $30,000, together with $10,000 in cash, was presented to the University, but the supreme need is a building rather than additions to the large collection which we now have.

Pres. Taylor: I am sure we all have been entertained and well informed by Dr. Tigert's address, and I want to say that back in 1905 — my first offense as a legislator — the Buckman Bill was considered and voted upon. It happened that one of those numerous institutions to be abolished was located in the county I represented. I had to vote against the Bill. I thought I was doing the right thing. I would have had to have done it anyway whether I thought it was right or not or move to another county, but I have been glad many times that the result of that Bill accomplished what it did. It established the College for Women and the University of Florida and the other institutions spoken of by Dr. Tigert.

That is not the only time I have been in the Legislature of the State of Florida, as many of you know, and I believe if I was Governor of Florida (which I at one time was willing to be), that before any legislation effecting the schools or institutions of higher learning came up for consideration, I would convene the Legislature in joint session, and ask Dr. Tigert to come up there, and talk to that body and tell them about these institutions, and particularly the University of Florida. I believe that body would be convinced, and it would at least do everything it possibly could for these institutions. I think in a general way a great many of them have done that in the past, but as he says, "the members don't know what's going on down here;" they don't know the studies and needs of this institution, and others in this state as well as they might; they have their own business affairs at home that occupy their attention, and all that, but I will tell you one thing — I have never voted against an appropriation for the University of Florida, or any other institution of learning in this State. I was always willing for the State to contribute, as far as it was able to do, as much as any man who ever went to the Legislature. It's not a very good time to talk about appropriation now; if you go up there and talk about appropriations they will probably ride you out of town on a rail, or do something else that is worse. But anyway, these institutions must be taken care of, and carried along, and the museum and other things must be provided for, and I hope that before Dr. Tigert passes out of the picture he will see it made what he would like to see it.

ANNOUNCEMENT

The Gainesville Garden Club invites the ladies of the convention to a tea to be given at Mrs. M. M. Parrish's at six o'clock Wednesday evening, in honor of Mrs. Charles Watson Ten Eyck, President of the State Federation of Garden Clubs.

THE GARDEN CLUB MOVEMENT IN FLORIDA

Mrs. Chas. W. Ten Eyck, President Florida Federation of Garden Clubs, Hollywood

The Garden Club Movement in Florida is as old as the State and as new as today. In the beginning the picture was a garden — many gardens for the length and breadth of her rolling high pinelands, her intriguing cypress and hammocks, her lapping seashores, her moss-covered oak forests, her friendly birds and native flowers, a composite of Indian, Spanish, French and English, interweaving the temperate and the tropical. Truly a Flora-da.

Bartram wrote extensively of his findings. Botanists roamed through virgin gardens to their hearts' delight. Old records and books speak continually of the untouched resources and values in her plant life. Early settlers exchanged seeds and cuttings, asked about native materials found, frequently leaving interesting and timely diaries or data. More than fifty years ago one traveler wrote "Such teeming gardens; such brilliant flowers; such wide fields; such noble groves of grand old live-oaks and magnolias; such a tropical luxuriance of tangled vines — winding avenues leading from the water to the housepark." In Jacksonville at the same time, we find "ample grounds laid out in tasteful gardens and lawns. Sometimes these gardens are perfect little parks and the fruits, flowers and shrubs all indicate a semi-tropical region."

The visitors waxed eloquent over Tallahassee's "lawns and gardens — well-kept and flowers, flowers, flowers! Everywhere in the greatest abundance, flowers! A most creditable pride in their lovely home grounds is exhibited by the citizens who seem to have a friendly rivalry in this beautiful ornament of nature, that is expression of culture and a fine taste for the beautiful. Tallahassee is truly a Floral City." And again, "a beautiful custom is the floral fair of Tallahassee, held in March, 1880 — a beautiful sight with a profuse display of flowers of all varieties, kinds, forms, colors and perfumes, all artistically arranged and exhibited to the best advantage."

Orange County, active now, was no less flower-show minded half a century ago for "there was quite a varied and handsome display in the floral and botanical departments embracing divers specimens of the coleus, ferns, Brazilian plants, pampas grass, jaunty jasmines." Which proves that the same lure of growing and showing things is in Florida, permanently. For the recent movement, organized in circles, neighborhoods and towns, is only possible on the foundation laid throughout past history by the chain of contributing plant minds who have gone before. I wonder what R. D. Hoyt and Norman Reasoner's father would say to the thousands of garden club members who have linked themselves indelibly with their pioneer work and with the Horticultural Society which they founded, as a great wall of defense against destruction of our heritage and for the increasing knowledge and practice of gardening. Charles Torrey Simpson gives them a place in his scheme of things when he dedicated one of his books "to the Women of the Florida Garden Clubs who have faithfully, intelligently and effectively labored to beautify our State." Each club has its Marys and Marthas — both sitting at the feet of the masters and busy about the horticultural housekeeping.

In days of quilting parties and camp meetings, women exchanged formulas, cuttings and information. Having no longer the quiltings, we spend more time on the mutual giving and taking of plant lore and materials. Higher education has brought to women, deeper training in botany, in landscaping, in propagation; the great wish to express herself and to have for her family a lovely garden, has brought to womankind this outlet for her innate love and talent for beauty.

Nor are the men missing. I find them as keen and anxious as we, even though they seldom speak of it in public. Since the garden of Eden, which contained everything, they have been seeking to recreate a complete garden. Wives of Horticulturists and Garden Club husbands are our best

critics. Men are members of most of our clubs; men are presidents of three of them.

Do you remember the hours spent in embroidering passive pansies, shaded appleblossoms, rich red roses with scattering petals? We spend hours today on an equally beautiful piece of embroidery — whose hoops are the property or town lines, walls, gateways; sometimes large hoops, sometimes very small ones; whose material is no longer the linens, the silks and the net but muck and marl, pine sand, rocks; whose threads are no more the shades and tones of floss but seeds, cuttings, plants, trees; whose needles and scissors have become the shears, the sprayer and the trowel.

And of those who garden — who plan and tend and enjoy growing things, there is a great difference of knowledge and ability, to each in her spot of earth. The novice comes timidly with all the questions, the do's and dont's, trying to make up for lack of botany background, lack of money, and perhaps very few months in Florida. One only learns by trying. And by trying, one evolves a garden of love and labor. The semi-professional or average gardener, goes scouting for new ideas, new materials, better methods, meantime sharing plants, gathered seeds, clumps of violets, an extra tree and some helpful hints, with a neighbor. She forms the mainstay of the Garden Club and the community. She knows the nurseries and catalogues, the plant names, the good speakers, the general information for which we hunger at circle meetings and open discussions. Added to these are the rare talented creatures of professional experience, correct knowledge, tried technique in planning and planting; endless abilities and ideas. And then those highlights in any club or city — those who speak with gifted tongue, active mind and vision of spirit — to cheer, to enthuse, to shake us out of our slumps and failures, our insects and our diseases, our doubts and our dangers — to say just the right word with a smile, spirit gardening, to carry us into greater heights and depths as to what it all means, putting into words our own inmost thoughts which we feel so incapable of expressing; and sending us on our way with renewed interest and hopes and blessing. Thus Gardens and Gardeners!

The Florida Federation of Garden Clubs, seven years old this month, was formed "to coordinate the interests of the Garden Clubs of the State and to bring them into closer relations of mutual helpfulness by association, conference and correspondence — to aid in the protection of trees, shrubs, wild flowers and birds; to encourage civic beauty and to study in all its aspects the fine art of Gardening."

Built under the capable leadership of such presidents as Mrs. Joseph Ellicott of Daytona Beach, Mrs. Arthur G. Cummer of Jacksonville, and Mrs. Edwin Riggs of Winter Park, it has grown from three clubs to thirty-seven; from a few dozen members to almost four thousand. It extends from Tallahassee to Miami Beach. It ties into similar functions and purposes, the red-clay hills of West Florida, the lakes and slopes of the Ridge, the black muck of the Everglades, the beach sands of Ocean and Gulf. It links the swaying coconut and mahogany to the native orchids, dogwood, pecans and subtle jasmines. And through membership in the National Council of State Garden Club Federations, adds a tropical theme to that greater pattern which has for its other three corners, Maine, Washington, and California.

The Garden Clubs of Florida serve as faithful non-commissioned officers between the great army of citizens who enjoy the fine art of growing plants and those mighty men of Botany and Horticulture, dear to us all and leading in research, experiment and thought. Their interests are as broad as Bailey's Cyclopedia, from seed beds to city planting, from an orange blossom to the Everglades National Park.

Splendid work is accomplished through directors who are in constant touch with the individual clubs and members; through comprehensive programs of Beautification, Conservation, Billboards and Roadsides, Native and Introduced Materials, Visiting Gardens at home and abroad; through educational and delightful Flower Shows; through conferences and conventions and wholesome exchange of ideas, inspirations and

implements. One very large club this year gave one thousand dollars to the unemployment fund in place of its annual Flower Show; another had every member working many days on Garden Club projects and paid for by the municipality.

Thus Garden Clubs, though fundamentally study clubs, have firmly established themselves as part of the civic background in their state. School grounds, roads, parks and great areas feel the influence of these unselfish and plant-minded men and women. Special celebrations and plantings for the Bicentennary of George Washington, have touched every club and neighborhood. Each has entered into the spirit and practice of his example, toward the conservation and creation of the best in tree life. Whether by acres, by hundreds, or as a single garden specimen, these dedicated memorials will link all members of the Federation to each other and to this National Remembrance.

I should like to minimize the Club and the Federation in our name and give emphasis to *Garden* and *Florida*. *Florida*, whether it be by birth or adoption, our state, for a short or a long time, is the key to our Federation of Garden Clubs. Men and women of *Florida* building gardens in *Florida* with *Florida* flora as *Florida* visions for *Florida* generations. Surely a challenge to the best that is within us.

THE ROLE OF THE LESS COMMON ELEMENTS IN PLANT LIFE

Dr. R. V. Allison, Belle Glade

In our discussion of "The Importance of Certain Special Elements in the Agriculture of South Florida" in the meeting at Miami last year particular emphasis was placed, at that time, upon the exceptionally important role copper, manganese and zinc are playing in the agriculture of that section of the state. Upon the present occasion your Secretary has asked that the subject be covered in a rather more general way in order that the unusual scope of this comparatively new field in plant nutrition may be brought more clearly into view.

At that time, too, opportunity was taken to point out the vital connection which studies along this line have with those pertaining to many important phases of animal nutrition. Further reference will not be made to this close association of interests in the present paper but with the rapid development that is taking place in the field of human and animal nutrition which bears so closely, at many points, upon the natural occurrence of certain of these special elements in feedstuffs and foods, it would seem entirely proper that we carry the two along together in our minds just as far as it is found possible to do so. This would seem particularly appropriate since such a large part of our plant products is destined to be consumed by us as food either directly or indirectly through livestock.

* * *

At the present time ninety-two chemical elements definitely have taken their places in the periodic table. A glance through the literature of plant nutrition will show that up to the present time more than fifty of these have been investigated for any role or connection they might be found to have in this important field.

Of this latter number, the famous ten, of long standing, namely, carbon, hydrogen, oxygen, nitrogen, sulfur, phosphorus, calcium, magnesium, potassium and iron still hold their original place, securely, in the constitution of plant life. During comparatively recent times, however, plant physiologists have added to this list, one after another, an additional group of what have come to be regarded in most instances as equally necessary elements in the metabolism of the plant. Not a few of these have been the subject of serious contention from time to time among individuals or groups of workers just as many of those in the earlier group doubtless were before their individual position had been firmly established.

In consequence of a tremendous amount of careful research work that has been carried out during our own time, therefore, we have an additional group of ten elements which may come to be associated with the original number as basically necessary for plant development. At least each one of these can find its ardent advocates for the cause. Naturally the position of some of these is much stronger then that of others. This latter group is, in their alphabetical order, aluminum, boron, chlorine, copper, fluorine, iodine, manganese, silicon, sodium and zinc. Perhaps sodium is the weakest of the group in the support it has for its place in the list. Osterhout* (1912), however, found it as necessary for marine plants as for animals.

In addition to these two groups of elements of established importance in the nutrition and composition of the plant we have a third and larger group of thirty or more which constitutes, as it were, the playground of the science. In this larger group are to be found individual elements upon which a considerable amount of work has been done in the study of their possible connection with plant growth or with living processes in general. Others of them have been investigated only to a lesser degree. In the case of a number of them a considerable amount of careful analytical work has been carried out both upon soils and plant materials by Failyer (1910), Robinson (1914) (1917), Headden (1921), Thomas (1923), McHargue (1925), Katlenberg and Kloss (1929), Bertrand and Levy (1931) and others in an effort to associate plant and soil composition more closely and to gain a better insight into the role and importance of some of these newer elements in plant life. This tertiary list referred to might be made up as follows: antimony, arsenic, barium, bromide, cadmium, cerium, cesium, chromium, cobalt, glucinum, gold, lanthamum, lead, lithium, mercury, molybdenum, nickel, palladium, platinum, radium, rubidium, ruthenium, selenium, silver, strontium, thorium, tin, titanium, tungsten, uranium, vanadium, and zirconium.

In the investigation of the association of some of these elements with plant growth in the past it has been a rather common practice to group certain of them such as uranium, thorium, radium and others of the radio-active group under "radio-active" fertilizers and still others and a larger group—most any of them in fact—under "catalytic" fertilizers where certain of these elements in the form of a crude salt or a crude ore was involved. Treatments of this nature have been applied in the past upon such a miscellany of soil types and crops and under such a variety of conditions that an accurate interpretation of the results is exceedingly difficult.

It is apparent that we shall not be able to go into this group in any detail. As a matter of fact it is believed it will be much more profitable to spend what time we have upon group number two above. It is of interest to point out, however, that many sharp associations have been established between individual elements of this latter group and plant growth under certain conditions and it is apparent that it offers a broad field of work for the future. Reference might be made particularly to the work that has been done with arsenic, cobalt, lead, lithium and nickel.

ALUMINUM

The definite need for aluminum in plant growth appears to have been established by Maze (1915) (1919) with corn and confirmed to a considerable extent by Sommer (1926) with peas and millet. Yamano, as early as 1905, however, had obtained definite stimulation of barley and flax and Pfeffer and Blanck (1913) obtained slight stimulation with the use of this element upon small grains though only when used in combination with manganese.

A considerable amount of analytical work has established the rather general dissemination of the element in plant material and soils though McCollum (1928) declared it is not a regular constituent of plant or animal tissues. His findings in this connection have been countered rather fully by Kuhlenberg and Kloss (1929), Bertrand and Levy (1931) and numerous others where it has been shown that the element is rather generally distributed both in plant and animal materials.

The mobillity of this element under acid soil

*Anyone interested in the literature references in this paper can obtain same by writing Dr. R. V. Allison at Belle Glade, Fla.

conditions and its ready assimilation by most plants under such conditions with consequent inimical effects, has been the subject of as extensive investigations by soil chemsits as any other single problem connected with this phase of plant nutrition. As is well known, the most practical cure for this condition, when present in the soil, is a liberal application of lime or superphosphate.

BORON

Boron was found markedly stimulative and considered essential by Brenchley as early as 1914. Nakamura, however, already had observed stimulation of peas and spinach with a very light application of it to the soil as early as 1903. Maze confirmed Dr. Brenchley in her opinion upon the importance of the element in plant nutrition, in 1915. A notable amount of confirmatory work has followed this latter date by Brenchley (1924 and 1926), Warington (1926), Sommer (1926), Swanbeck (1927), Shive (1928), Sommer (1928), Haas (1929), Johnson and Dore (1928-29), McMurtrey (1929), McHargue (1930), Haas and Klotz (1931), Johnson and Fisher (1930), and others. Of necessity the favorable influence of this element, whether in solution or soil culture, must be brought out under conditions of moderate to very weak concentrations of the element as it becomes severely toxic with increasing dosage.

CHLORINE, FLUORINE, IODINE

While there is a considerable question in the minds of some physiologists as to the absolutely essential nature of any or all of these members of the halogen group, the important and consistent work reported by Maze (1915) (1919) upon them should provide serious support for their cause in this connection.

The distribution and general prevalence of all three elements in plant material has been studied in detail by a number of workers and rather fully established. In this connection iodine has been given particular attention especially for its alleged relation to human pathology in respect to the occurrence of goiter.

In support of the work of Maze upon this group, Tottingham (1915) (1917) found pronounced response of plants to chlorine in sand and soil cultures and is inclined to regard it a necessary element upon the bases of results obtained in his studies. The further opinion is expressed, however, that its action appears rather specific to the plants involved as well as to the character of local climatic conditions. Prianishnikov (1905), also working in sand and water cultures, did not find stimulation to the element that would indicate it as of a necessary character. Neither did Voelcker (1900) or Shulov (1909) find that it appeared as a necessary element in their work with plants. Subsequently, however, Anderson and Swanbeck (1929) as well as Garner (1930) have obtained definite stimulation with the use of the element upon tobacco under field conditions. Favorable results frequently have been obtained with the use of sodium chloride (agricultural salt) under field conditions. Much of this work has been carried on without adequate controls. It is believed that a considerable amount of the prompt benefit that has appeared, as a result of the treatments, has been due to exchange effects in the soil complex which the sodium ion has been able to perform, with the consequent release of certain elements for the use of the plant. That this procedure is not a desirable one for several reasons need scarcely be mentioned.

As regards fluorine, Aso (1906) obtained important stimulative effects upon plants with the use of the fluoride of calcium in soil cultures that were attributed to this element used in this way. Gautier (1915), Gautier and Clausman (1919) and Voelcker (1921), among others, also obtained important stimulation of plant growth with the use of fluorine. In a similar way Suzuki (1903), and Vinson (1916) showed stimulation of plant growth with the use of iodine. These results are of particular interest for the support they lend to the findings of Maze, which led him to declare that these elements should be included in the "essential" group.

SILICON

The need for silicon in plant nutrition has been the subject for rather intensive study for a number of years though its free assimilation by practically all species under natural conditions has

had little occasion for questioning. The matter of its essential nature for normal plant growth, however, has not been so completely settled. Gufferoy, Creplaux and Milon (1905), studying the value of certain slags in considerable detail, found the presence of silicon of serious importance in the development of buckwheat and other crops. Voelcker (1920) also found marked benefit from the use of Calcium silicate upon wheat in pot cultures. In a statistical study of results at Rothamsted involving the application of sodium silicate to barley, Fisher (1929), however, is of the opinion that the rather considerable benefit that has followed its use has been due to the replacement of phosphate reserves in the soil by the silicate, thus rendering an additional supply of phosphoric acid availabale to the plant. In more recent work upon the essential nature of the element in plant growth Sommer (1926) is of the opinion that it may be essential to the growth of rice. In this work it was also observed that seeds of millet, grown without silicon, were seriously infected by fungi while those receiving the element in the nutrient solution were not attacked.

COPPER, MANGANESE AND ZINC

Due to the attention that was given these elements in our discussion of the work last year they will be treated with comparative brevity although it is recognized that the first two, at least so far as we are concerned here in Florida, rank among the most important in the secondary group which is now under discussion.

In connection with the direct stimulation of plant growth through treatment with copper there are probably more references in the literature to this relation than that of any other element in our secondary group except it be manganese. This is particularly true on account of the intimate application of the element to the foliage of plants in the form of Bordeaux sprays that have been in use for many years. It is in connection with the use of the metal in treatments of this kind that the important effect it so frequently exerts, both upon the color and development of the foliage, has been observed. Commonly this direct stimulation extends to the entire plant even including fruit that is produced subsequent to the treatment. Scores of references are available in the literature touching upon this relation and the interpretation of such effects is found to vary considerably. For instance there are those who hold the favorable action due to the direct influence of this surface film itself upon transpiration in one way or another, or to its activity in controlling the intensity of light coming to the leaf. On the other hand there are other workers who, knowing that the element may be assimilated in the leaf from this position, conceive of its entering more or less directly into the metabolism of the plant in one way or another.

Sufficient experimental work under carefully controlled conditions has been done along this line to establish the fact that the copper is actually assimilated into the leaf structure of green plants when applied to the surface in this manner. This was demonstrated beyond any doubt by the work of Bain in Tennessee as early as 1902. DeLong (1929), however, has even gone so far as to maintain that it is the concentration of copper in the sap of the potato leaf, following treatment with Bordeaux spray, which actually kills leafhoppers as they feed through such treated surfaces into the leaf tissue.

A considerable amount of work also has been done upon the natural occurrence of copper in soils, its accumulation in soils as a residue of spraying and the assimilation of the element into the plant system in a normal way through the roots under such conditions. Maquenne and Demoussy (1919) claim to have found copper in practically all soils but much more in those of vineyards than others; whereas Robinson (1914) could not establish the element with certainty in any of the normal soils examined.

As early as 1892, Collier showed the influence of copper in the soil on the color and development of vegetation and also showed that it was taken up and stored in the plant in very appreciable quantities. The latter point of assimilation through the roots was indicated by the work of Otto in 1894; also in a very systematic way by Cook in 1921 who found potato plants taking up copper readily from soil treatment with such insoluble forms as Bordeaux mixture with apparent benefit to color and development.

Vedroi (1896) analyzed numerous seeds for copper and found its occurrence quite general, running as high as 680 p.p.m. in winter wheat and 1350 p.p.m. in pepper pods. McDougall (1899) found that the assimilation of copper was not selective and the metal tended to accumulate in some plants. Thus he found the dead wood of *Quercus macrocarpa* to have as much as 500 p.p.m. of the metal. McHargue (1925) also found copper consistently in miscellaneous plant and animal materials.

The character of the action of copper in its effect upon plant growth was studied as early as 1894 by Tschirch who found the oxid of the element to produce markedly beneficial results in water culture. He also found plants in coppered soil assimilating the element. As late as 1910, however, Brenchley found no stimulation in plant development even from very weak concentrations in water culture, though in 1914 she reported the occurrence of stimulation under certain special conditions. Montemartini (1911) found grapes, beans, potatoes and other plants markedly affected in respiration and otherwise by treatment with copper while Voelcker experienced marked stimulation of wheat in pot cultures with small dosages of the element. Maquenne and Demoussy (1920) found that copper moves and apparently accumulates in the plant in harmony with certain nutritive processes. According to them this movement appears greatly facilitated by the presence of calcium. As a result of later work in water cultures during the same year they are rather of the opinion that the element does not act in a purely nutritive way in the plant but express the belief that, under certain conditions, in certain media, it may exert something of an antitoxic function of a highly acceptable nature to plants growing under such conditions.

Stocklasa (1911), in studying the stimulation of beets by copper decided that the relation must be of a catalytic character and the important function which it performed in this connection is in promoting rapid carbon assimilation and photosynthetic activity through its effect upon the chlorophyll apparatus. This is supported in a way by Chuard and Porchet (1900) when they maintained that assimilation of copper does not increase the chlorophyll content of the plant. Densch and Humins (1924), however, after noting the marked improvement in development and color of plants as a result of copper treatment were rather of the opinion that it was replacing iron in the chlorophyll.

By way of a direct examination of the role of copper in plant nutrition McHargue (1927) (1930) working with bluegrass and oats in sand culture found that this element was important if not necessary under those conditions for normal growth. Sommer (1931) in working with solution cultures and under conditions generally similar to those of McHargue, found a remarkable stimulation to follow the inclusion of copper in the nutrient solution at the rate of six parts of the metal in one hundred million of the solution. Plant development in the absence of the element was so dwarfed and abnormal that essential agreement with McHargue is reached in declaring the metal essential.

So far as important applications of these studies with copper are concerned perhaps one of the most interesting and striking is that of its use upon raw, organic soils such as we have applied it to in the Everglades. No response could be more striking. Failure in the absence of copper treatment under field conditions is quite as complete, or more so, in the case of most plants, as that shown by Sommer (1931) in cultures where the copper was withheld from the solution. Studies of the stimulating effects upon plant development that follow the treatment f certain organic soils with this element were carried out more or less simultaneously with ours in Florida (1927), by Hudig (1926) in Holland, Felix (1927) New York and Smith (1927) in Holland. As early as 1904, however, Kanda, in Japan had observed that while copper sulfate was injurious to pea seedlings even in very dilute concentrations in water cultures it appeared to exert a decidedly stimulating influence upon growth when added to humus soils. Franklin (1914) also experienced more or less similar results when he tried to destroy a growth of "Horsetail" weeds in a cranberry bog by pouring a comparatively strong solution of copper sulfate about the roots of the plants through

holes punched into the soil for this purpose. Instead of killing the plant it was found that they were markedly stimulated by the treatment. In 1917 Van Feilitzen in Sweden, also observed a similar stimulation of plant growth to follow treatment of humus soils with bluestone where it was incorporated in a series of soil treatments with other materials which were being tested more as sterilizants.

In commenting upon the striking results obtained with the use of copper in our Everglades work Sommer (1931) has declared that they do not furnish conclusive evidence as to the so-called essential nature of copper in plant growth. While we have no particularly urgent ambition that they serve this purpose I am obliged to point out that any or all of us should be very careful at all times against dictating to the plant in too hurried a manner under what conditions of general environment it is to regard itself as at an absolute normal. Work in solution culture is under highly artificial conditions at all times so far as the plants and methods of procedure most commonly employed are concerned. In other words it is entirely possible that there may be set up by a growing plant in such a root environment, special chemical conditions, so far as its relation to copper stimulation are concerned, which are not markedly different from those which may be present in our organic soil, and against which, in one way or another, the plants are protected when access is given to available metallic copper. As a partial protection, at least, against the development of such conditions of essential stagnation in artificial culture it is believed that direct aeration of the substratum or continuous renewal of the nutrient solution should be adopted.

As a further illustration the unusual results that have been obtained with the application of copper to foliage or to soils in the way of plant stimulation under particular conditions, this element has been used for many years in connection with the well known dieback (Exanthema) disease of citrus trees in Florida and elsewhere. This treatment was discussed by Floyd in 1917 as of long standing at that time and is in common use for this same condition at the present time. In his treatment of the subject Floyd refers to the fact that equally effective results are obtained whether the treatment is given to the soil or put on as a Bordeaux spray. The current practice is to use as much as four pounds of the chemical (bluestone) per tree.

In view of the fact that this condition has been characterized as most commonly associated with excessive organic matter in the soil or excesses of organic ammonia from other sources, the thought is expressed that the essential character of the beneficial effects experienced by trees suffering from this disease, when treated with copper sulfate (bluestone), may not be greatly different from those which citrus trees, or other plants, enjoy when treated with the same compound upon our sawgrass soils here in the Everglades. In the latter instance, however, it should be observed that without the early application of copper the trees, as a regular practice, do not get large enough to have typical die-back. They scarcely seem to get started. This response of citrus in the instance of our work in the Everglades, it will be remembered, was well shown in a series of slides last year.

In this connection it is of particular interest to note that Smith and Thomas (1928) working with a condition in certain apple, prune, pear and olive trees of California that very closely resembles our citrus exanthema that has been referred to above, obtained very striking results with the use of copper sulfate in the correction of the trouble and have found that trees, so treated, have fully recovered.

In reference to the role of manganese in plant nutrition it would be exceedingly difficult to check through the literature covering the results that have been obtained through fertilization of a great variety of farm crops with this element in all parts of the world during the past few decades without developing a real appreciation for its importance in the metabolism and development of green plants. Although the fact of its assimilation was established by Scheele as early as 1788, Plant Physiologists of that and subsequent periods appear to have overlooked to a very considerable extent, the full importance of the element in this connection.

In 1903, however, Nagaoka, as well as Aso, studied the relation of manganese to rice culture. Likewise Bertrand, in 1905, demonstrated its striking importance in the growth of oats. Sjollema and Hudig in 1909 were among the first, however, to show the essential dependence of plant response to the element upon soil reaction. During that year they summarized the results covering work began in the Netherlands in 1905 upon "Oat Sickness" and not only showed how the trouble could be cured by the application of manganese sulfate but also to what extent its occurrence was associated with excesses of lime in the soil and how it was this excessive alkalinity which brought about the inavailability of the element and so produced the disease. More recently, Samuel and Piper (1928) have worked upon what appears to be this same condition in oats in Australia where it is referred to as "Grey Speck" and they also have found prompt relief with the use of manganese; also with the application of acid-producing fertilizers to the soil concerned. In 1907, Skinner laid out a series of tests with the element upon a comparatively acid soil upon the Arlington Farm near Washington but no response was obtained during the early period of the experiment to manganese or at any time until after 1913 when the entire series of plots was limed. A very definite stimulation of plant growth then appeared upon the plots that had received manganese earlier. Application of this relation established in these early studies was made upon the marls of Florida in 1927 where similar deficiencies in available manganese were discovered and corrected through proper treatment.

As early as 1910 Brenchley showed that manganese in very slight concentrations in solution culture was definitely stimulative to plant growth. About this same time Schreiner, Sullivan and Reid indicated the possibility of this element playing an important role in the oxidation processes of the soil. Other explanations of the action of the element in its effect upon plant development, especially under natural conditions in the soil that were to be found in the literature are: catalyses of cell activity, oxidation of toxic substances in the leaves, production of chlorophyll, role in stimulation of photosynthesis, stimulation of assimilation of elements, effect upon permeability relations for other ions, etc. A particular point that might be inferred from the work of Wilstatter (1909) is that it does not enter into the composition of the chlorophyll since he was able to establish only the presence of magnesium.

Following this earlier period of rather intensive research upon the subject, interest in the application of manganese to agriculture developed rapidly and a great amount of additional work was done upon various phases of the problem in the years that followed. Unfortunately, much of it was without systematic study of the soil reaction. The advent of soil reaction studies, in more recent times, upon the basis of hydrogen-ion concentration has, of course, greatly simplified this phase of the problem. An inspection of the results of this earlier work referred to, however, will indicate that a large majority of the trials, even under such miscellaneous field conditions as were involved, show decidedly positive results with the use of the element.

By 1923 and 1924, McHargue had indicated a prospective relation between the presence of this element in plants and the occurrence of certain vitamines. He published further in 1927, and later, by way of showing the important, if not essential, character of its activity in relation to plant growth. In 1927, Schreiner and Dawson published upon greenhouse work upon the lower east coast marls of Florida wherein the same relations between this element and plant growth were brought out as shown by Ruprecht and Skinner under field conditions in the same year. In that year, McLean (1927) of Rhode Island also brought out the fact that chlorotic plants, due to lack of manganese, can be treated as effectively with this element through the leaves as through the roots. The fact of leaf assimilation of various elements has been known for some time and was made particular use of in the work of Hiltner (1909) when he found copper and potash, as well as other elements taken up freely when applied in this way. Larue (1913) also experienced good success in the application of a number of different elements to the foliage

of a variety of plants. In connection with his work the conclusion was developed that spray mixtures, to be used as fungicides, might be prepared in such a way and in such proportions as to give the treatment a further value as an aerial fertilizer if the necessary degree of adherence can be secured to prevent its too prompt removal by rain. This method of application doubtless can be made important use of in connection with manganese treatment of plants particularly upon our more alkaline types of soil. This and other methods are being investigated in some detail at the Everglades Station at the present time.

In South Florida our chief problems involving excessive alkalinity in the soil and consequent need of manganese treatment arise (1) in those mineral soils naturally high in lime such as the marls of the lower east coast, or (2) in the alkaline peats or mucks of the Everglades, especially following burning. In the latter case the need for manganese treatment is found to be dependent not only upon the crop itself but also upon the severity of the burn, its recency, and the consequent accumulation of ash. In any event the use of copper as an absolutely necessary amendment upon raw, unburned peats, and of manganese upon them, especially after burning, makes of the two a very admirable pair of special elements for application to our rather unique conditions of soil and agriculture in the Everglades.

It would be exceedingly difficult to make anything of a complete survey of the literature or of the problems involved in the fullest application of this element, manganese, to our agriculture in so brief a time. It is sincerely believed, however, that the time has come when its importance in plant nutrition must be more fully recognized if greatest advantage is to be made of our natural resources in terms of soil fertility. In Florida, as in many other states, one can be almost certain that there are innumerable areas and situations in the relation of crops to soils where very marked benefit would follow careful attention to the matter of the availability of this element.

In respect to the role of zinc, the final element for consideration, in the nutrition of green plants it was found toxic, even in comparatively light concentrations, by Brenchley in 1914. Since that time, however, this element has been indicated by McHargue (1925) (1927) and by McHargue and Shedd (1930) as distinctly beneficial if not necessary in normal plant metabolism. Sommer and Lipman (1926) and Sommer (1928) also have indicated it as indispensably necessary in this role. In all of this later work exceedingly light concentrations of the element were used.

In much of the work with zinc that is recorded in the literature it has been grouped with "Catalytic" fertilizers and in consequence the results are of a highly miscellaneous character and frequently of rather doubtful significance. A considerable amount of interesting work has been done upon the relation of this element to the nutrition of certain of the fungi and other lower forms of plants and in this connection considerable importance is attached to the role it plays by a number of workers. In our work here in Florida this element has been uniquely effective in promoting an earlier stimulation in certain plants, notably the peanut, to copper treatment upon our sawgrass soil under certain conditions. In this latter connection it is of particular interest to note that Kanda (1904) working in Japan found that zinc when applied to humic soils produced a distinct stimulation in the growth of vetch. The use of zinc, alone, upon our sawgrass soils has produced slight stimulation in the case of a number of plants but never anything of permanent importance.

FLORIDA EXPERIMENT STATION,
BELLE GLADE.

SOIL ORGANIC MATTER

Dr. R. M. Barnette, Gainesville

Since the first meetings of the Florida State Horticultural Society, the problem of soil organic matter as related to various crops, and systems of soil management has been emphasized. It appears that the successful agriculturist has always given some attention to this soil organic matter problem and has learned that over a long period of years some care must be exercised in attempting to best utilize and maintain the chief source of the life of the soil, the soil organic matter. Up to the present, no other economical means have been found of keeping soils in general on a sound productive basis for furnishing necessary and usable products of the land. This one fact seems to run through the history of most agricultural practices attempted by man in his desire to utilize the soil.

There are evidently certain effects of natural processes which must control the utilization of the land. Certain of these factors are operative whether or not man interferes with them in his agricultural systems. These factors govern largely the development of cultural systems under changing economic conditions (from whatever cause these changes may be) and the successful utilization of the land. What are the factors, which man may or may not utilize or combat, or possibly by combating, utilize? What significance have these factors in man's utilization of the soil for present day purposes — and for what possible future purposes? These factors are most intimately associated with the soil organic matter or life of the soil.

According to Dr. Jenny of the Missouri Agricultural Experiment Station who has made a detailed study of several factors influencing soil organic matter, the following factors are of decreasing importance in their effects on soil organic matter content:

Climate,
Vegetation,
Parent Material,
Topography,
Age.

The climatic factors which influence soil organic matter are (1) temperature and (2) moisture. The following general rule has been found to possibly hold for soils of comparable characteristics outside of climatic factors: (1) For each fall of fifty degrees F. (ten degrees C.) in annual temperature, the average total nitrogen and organic matter content of the soil increases two to three times, provided the precipitation — evaporation ratio (moisture) is kept constant. (2) The effect of moisture is summarized as follows: Within regions of constant temperature the nitrogen and organic matter content of grassland soils increases with increasing humidity factors. The rate of increase is greater in northern than in southern regions. The nitrogen content of originally timbered soils shows little correlation with climatic moisture values.

The influence of vegetation may be summarized as follows: In general, under similar climatic and other soil conditions, grasslands have a higher organic matter and nitrogen content than do strictly timber lands.

Florida climatic conditions predicate a low organic matter content of the soil. High annual temperatures bring about a rapid "turn-over," or transformation of organic matter in the soil and a consequent low organic matter content under well-drained conditions.

The parent materials from which the Florida soils have been developed are for the most part unconsolidated sands, which predicates a favorable condition for oxidation, especially under the climatic conditions under which they were deposited.

Topography — chiefly by establishing drainage conditions — is of importance in the accumulation of organic matter in the soil. Sometimes even under the favorable climatic conditions of Florida for the destruction of organic matter, there is

possible an accumulation of organic matter due to drainage conditions which limit or in some instances practically exclude the oxidation of organic matter. This leads to the development of organic soils, and other soils formed under poor drainage conditions. The utilization of these lands presents individual and special problems of water control. When once drained and put to the culture of plants requiring well-drained conditions, they present the same problems of soil management as do well-drained soils under similar climatic conditions. In other words, their successful utilization under Florida climatic conditions is intimately associated with seasonal variations. Among these seasonal variations the distribution of rainfall seems to be of great importance.

Before discussing specific organic matter problems of Florida soils, it seems advisable to define the terms which are to be used. In the present discussion, at least, we may by this means have a common set of terms to use: "Soil organic matter" may be said to include not only the "decomposed organic matter," but also the "decomposing or rough organic matter." The "decomposed organic matter" sometimes called "humus" may be said to represent the organic materials of the soil which have undergone decomposition processes to such an extent as to have lost their original structural characteristics. In other words, the more readily decomposable materials have been removed and the more resistant materials are left. These with the present microbial population of the soil make up what the soil scientist usually considers as having an effect upon such soil properties as, color, water-holding capacity, and general long time potential fertility. The rough or "decomposing organic matter" represents the plant parts and other organic materials which are in the process of rotting in the soil. These materials have not lost their plant structures and represent the immediate most easily "digested" food supply for the soil microorganisms. It is easily understood that at any one time all forms of organic matter from the fresh materials to the decomposed organic matter or "humus" are in the soil. The soil investigator, while thoroughly appreciating the value of the desirable, even sometimes undesirable, processes taking place in the soil during the rotting processes, attempts to follow the ultimate effects of any system of soil management by estimating the effect on the "decomposed organic matter" or soil "humus." Such a procedure is evidently arbitrary but if followed on samples taken in a comparable manner over a period of years tends to throw light upon the manner in which the system of soil management is affecting the source of food supply, and consequently the potential population of soil microbes and ultimate life of the soil.

Observations have been made in great numbers on the rotting of different kinds of organic materials in the soil by measuring, usually chemically, the immediate products of the rotting processes. When taken under field conditions correlations must be made with the climatic factors of temperature and moisture (especially distribution of rainfall). The latter type of soil investigation is expensive both with regard to time consumed in making these observations to arrive at satisfactory averages, and the evident necessity of making these observations over a relatively long period of time to obtain correlations with climatic factors which are not misleading in formulating response in any particular culture.

Both types of observations have been made on Florida soils under different cultures by various methods of approach. Samples have been taken at intervals in a comparable manner from areas subjected to similar and definite practices. Thus the effect of the system of soil management on the "humus" or "decomposed organic matter" of the soil may be evaluated. The more expensive manner of soil investigation which involves the periodic observation of the products of decomposition on more or less definitely controlled areas under different managements have been made. Experiments in soil tanks have been attempted to study leaching effects. Other experiments in the field and under controlled conditions have been made to study different systems of handling and utilizing rough or "decomposing organic matter." These experiments and tests have not been confined to any one culture but have ex-

tended over several cultures, including perennial, annual and deciduous plants of economic importance today.

It seems desirable at this time to give a brief summary of these experiments and to allow the grower to draw his own conclusions with due regard to the type of culture he is attempting and the soil which he is utililzing.

Observations on well-drained soils brought into culture indicate a more or less progressive decrease in the "decomposed organic matter" or "humus" content of the soil with continued culture. This has been observed in both tank and field experiments. This fact is not new to the soil investigators, especially to those who have studied in the humid-tropical and subtropical regions. The extent to which the soil may lose its "humus" or "decomposed organic matter content" without ultimate disastrous results to the particular crop which it is growing is not known but possibly varies with the soil type (considered on the basis of all soil forming agencies) and the economic value of the crop produced (considered on the basis of demand for the crop-supply of the crop and quality in many instances). Suffice it to say that any process which ultimately removes the continuous basis of the life of the soil, however slow this removal might be, will lead to difficulties which have brought about an abandonment of the land from otherwise potentially profitable uses. This is by no means the only reason for the abandonment of lands as the economic value of possible known crops for a given soil varies too much with time and human demands to make a general rule. However, even considering the better types of land in crops today, in many instances, the "mining" of the soil which in common parlance, should be changed to the "murder" of the soil has led to economically unsound cultures and a return of the soil to uncultivated crops adapted to the conditions. This decrease in the "decomposed organic matter" or "humus" content of the soil (when brought into culture, especially under conditions of high annual temperatures) associated wtih high moisture conditions is evidently due to a limitation of the space given over to the production of organic matter to stimulate decomposition of organic material by cultivation and to possible other reasons.

This brings our major and immediate problem with respect to soil organic matter down to a question of growing and utilizing the organic matter to be decomposed in the soil for the season, or supplying the needs of the soil from outside sources. Such a procedure is contingent upon the utilization of all information available with regard to growing and utilizing organic matter and maintaining economical crop production at the same time.

Under Florida conditions for the majority of the soils in cultures, the chief factor to be considered from a soil viewpoint is the moisture supply. The distribution of rainfall evidently determines many cultural operations which we should or should not attempt. For instance, from periodic determinations of the decomposition products of organic matter, whether leguminous or non-leguminous, there was a better correlation between the distribution of rainfall during the crucial growing period of a crop and the crop yields than between the presence and absence of organic matter for a given season on a particular soil. The growing of the cover crop or organic matter in general is thus dependent upon the season, particularly upon the distribution of rainfall.

The utililzation of its decomposition products by another plant is dependent upon the type of plant and the season.

That a crop, whether cover crop or otherwise, however sparse, will decrease the leaching of water and water soluble materials from the soil is evident and abundantly confirmed by experiments. Tank experiments have shown a distinct saving in the quantity of materials which leach out of the soil during the Florida rainy season, when a crop is growing on the soil. Usually the decrease in leaching is proportionate to the dry weight of plant material produced, which in turn is controlled by the distribution of rainfall during the maximum growing season of the plant. Ordinarily, such a cover crop as Crotalaria striata shows a marked conservation of water during a distinct rainy season. Such

crops as cowpeas, where handled properly and repeatedly planted two or three times during the season have been found effective in cutting down the leaching. Velvet beans are ordinarily quite effective also. Non-leguminous annual grasses are satisfactorily used for the same purpose where nitrogen is not a limiting factor.

The crops to use for cutting down the leaching from well-drained soils is not a specific one for the soil scientist to answer for all conditions. This is a problem for the individual grower to answer for his own particular soil conditions, and the crop in which he is economically interested. The chief thing to keep in mind is that during periods of excessive rain to prevent leaching from the soil by the most economical means at your disposal. This holds in general for practically all cultures. If growers of different crops wish to formulate a rule to follow with regard to which cover crop to use, it is suggested that they study the observations of the nearest weather station, especially with regard to the distribution of rainfall, and select that crop which makes the maximum growth during the period which on an average of a number of years has the greatest rainfall. If this crop happens to be a non-legume you will probably find it profitable under present conditions to stimulate its growth by additional applications of cheap sources of nitrogen. After you have made these observations and selected your cover crop, and there comes a season when it is a failure, don't be discouraged, the chances are with you.

In connection with the processes of rotting of soil organic matter and the response of planted crops there is one thing which the soil scientist has explained to his own satisfaction. This is the difference between the rotting of a mature legume as compared with a mature non-legume. The legume contains a high amount of protein compounds — nitrogen compounds; the non-legume a low percentage. In the decomposition of these two types of materials the micro-organisms of the soil act differently. If protein materials are present in large amounts the micro-organisms use them both as sources of nitrogen compounds and of carbon compounds. The nitrogen is in excess, consequently the micro-organisms discard the over-supply which is transposed by other microbes into desirable compounds for plant utilization. When the rotting of such plant materials is carried out under favorable conditions it constitutes a valuable means of stimulating plant growth.

On the other hand, the abundant supply of carbonaceous materials available to the micro-organisms in mature non-leguminous plants in comparison to the low supply of nitrogenous materials, protein compounds, brings about a need for more nitrogenous compounds which are taken from the sources in the soil. This brings about a competition between the growing plant and the soil micro-organisms. This combat is usually won by the soil micro-organisms as they increase in numbers quite rapidly under conditions of favorable food supply, moisture and temperature. The growing plant usually suffers from a lack of nitrogen, and if a flourishing condition is to be maintained, a supply of nitrogen must be given in the form of some other nitrogenous salt or other high nitrogen-containing material. Later on if another supply of low nitrogen-content material is not given the soil, we find that due to a lack of food the microbes die off and subsequently their bodies are attacked by still another group of microbes to be utilized and changed over into desirable products for plant growth.

The question of how to handle the organic matter grown on a soil to best advantage is also asked by many. Several possible systems have been subjected to experimental tests. These tests have been made under controlled conditions and in some instances field trials. It appears that a system of mulching conserves moisture, cuts down evaporation, under some conditions increases the quantity of leaching but decreases the quantity of elements leached within a given leaching period. Temperature is evidently equalized or regulated by mulches. The period of decomposition of the rough or "decomposing organic matter" is extended by mulching. Even under these conditions tests with Crotalaria spectabilis have shown that from fall to spring about fifty per cent of the organic material allowed to stay on top of the soil has been decomposed and lost

unless some plant was using it. These were actually dry weight determinations. The leaves and small stems of the Crotalaria plant evidently decompose first as has been determined by laboratory experiments and correlated with the composition and physical makeup of the plant parts. Incorporation of organic matter in a manner similar to that of discing (mixing with a few inches of soil) leads to a rapid decay of organic matter and a rapid availabillty of the products to plant growth. If favorable moisture conditions are present a good utilization, an efficient utilization, of these decomposition products is realized. On the other hand, if leaching conditions occur there will follow a poor utilization of the incorporated material or if an extreme drought occurs, there will also be poor utilization. Evidently deep incorparation in a layer is seldom practiced in Florida and needs scanty mention.

One other technical point is important. Why all this talk about "leaching," about "availability," about "distribution of rainfall," about "life of the soil." The answer may seem simple but it is fundamental, just the same. As far as it has been possible to determine to date, the "turnover," the "saving," the "utilization" of cultural systems involving organic matter under Florida conditions are intimately concerned with the use of essential plant food elements by a plant or plants and the release of these same elements by biological processes in a manner to stimulate the production of economical crops. This "turnover" of essential plant food elements in general is apparently associated with the biological decomposition of organic matter in the soil. A balanced soil condition for plant growth may at present be most economically maintained by such life processes. This balance of soil solution, the use of applied fertilizers by crops other than the cultivated crops and the release of these elements to the crop in culture or subsequently cultivated crops are of extreme importance under Florida conditions.

Finally it is apparent that definite rules of soil management with regard to organic matter are most difficult to formulate and dependent upon localized cultures and crop adaptations.

PRACTICAL METHODS OF FEEDING CITRUS TREES

Leo H. Wilson, Bradenton

My subject has been abused very badly the last few years. I wonder at times how the citrus industry has survived. We have proven by our methods of fertilization, how near the citrus tree is fool proof. Is there another industry in the world that has been tampered with as our citrus industry in regards to fertilization? Just how practical have we been in recent years? Our feeding program has varied, so has our income from citrus fruits. Of course there was a reason. The economic conditions have forced the grower to practice economy in feeding his trees. And I believe a great deal of this practice has been false economy, and at this time, I am glad to see the grower turning away from unproven practices, back to a safer program of citrus fertilization.

The fertilizer program for the Florida citrus grower must always be an elastic one. With our variation in soil type, moisture, varieties, root stock and temperature, it is impossible to follow a definite feeding program for citrus. Out of these variations, I believe moisture to be one of the principal limiting factors in the successful production of citrus fruit. After going through the last twelve months of unusually dry seasons, we naturally draw this conclusion. The present drouth has certainly influenced and hastened the poor conditions showing up over the citrus belt, which is a direct result in many cases from fertilization practices.

As stated above, it is not practical to make any definite recommendations for feeding citrus trees. Variety of soil type, with factors as age

and general condition of the trees, size of the crop carried, previous treatment, variety of fruit, root stock, moisture, fertility of the soil and so on, influence the kind and amount of fertilizer needed. As an example, three pounds of a complete fertilizer is considered ample for trees in their first year, while old bearing trees thirty, forty years and up, may respond economically to sixty to seventy-five and 100 pounds annually. But with all these factors entering in, there are several important factors all growers must have present if best results are obtained from their chosen fertilizer program. Here they are:

The soil must be well supplied with bacteria, humus and organic matter. Except where trees are crowded, the most economical way to apply this material is by growing cover crops of grasses, or legume crops such as crotalaria, cowpeas, beggarweed and velvet beans. I feel confident the cover crop system should be more rigidly encouraged. A soil well supplied with decayed vegetable matter, materially increases the water holding capacity, so vital in a time of drouth, and the part it plays in making available the soil plant food.

Where soils are depleted, or the soil is shaded by the trees to such an extent as to prevent the growth of cover crops, the grower may add the desired amount of humus and nitrifying bacteria by hauling in large amounts of grass, legume crops, leaf mold, muck, barn yard manure, citrus pulp, and other rough, cheap forms of organic matter, and broadcast in the middles and well up around the trees. When these materials become thoroughly decomposed in the soil, our attention may then be turned to our fertilization program.

In the beginning, we were taught to feed citrus trees a balanced fertilizer composed of the three essential elements, called ammonia, phosphoric acid and potash. In discussing my subject last week with a leading citrus grower, he advised me to say these few words. "Use plenty of common horse sense in feeding citrus." With that as a motto, and the grower receiving good prices for fruit, we would have little excuse for hedging in feeding our groves, and a fertilizer program of "Just To Get By" would soon be a thing of the past.

There are three main seasons of the year in which to fertilize citrus. The fall, spring and summer. And the fall application is considered the most important, making the application in November or early December on bearing trees, and September for non-bearing. The fall application on bearing trees has a decided influence on the crop produced the following spring. While the trees are generally dormant, they are storing up plant food that will greatly influence the set of the new crop and the time of maturity A formula analyzing four per cent ammonia, six per cent phosphoric acid, and eight per cent potash may be used on grapefruit, tangerines, and pineapple oranges, while a 3-6-8 for Valencias and other oranges may be used.

From thirty-five to fifty per cent of the ammonia should be in the water insoluble organic form, and derived from such standard materials as Bone Meal, Castor Pomace, Peruvian Guano, Goat Manure and Tobacco Stems. The balance of the phosphoric acid from Superphosphate, and the Potash from Sulphate.

The spring application may be composed of chemicals altogether, applied the later part of January or early February. If a complete fertililzer is not needed, you may omit the phosphoric acid, and use ammonia and potash as a top dressing. A combination of Nitrate of Soda, Sulphate of Ammonia and Sulphate of Potash makes a very safe and economical spring mixture. However, in many cases straight applications of ammonia may be all that is necessary to push out the growth, set the new crop, and influence the early sizing of the fruit.

May and June is the time to make the summer application, but there are cases where it is very desirable to fertilize earlier, especially where early maturity is expected. In this application, the ammonia may vary from three to four per cent, depending upon the variety and size of the crop, six to eight per cent of phosphoric acid, and five to eight per cent potash. Reliable mixtures as a 4-8-8; 4-6-8; 4-6-5; 3-6-8; 3-8-5; or 4-8-5 may be used with a feeling of absolute safety. I believe twenty-five to forty per cent

of the ammonia in this application should be taken from water insoluble organic materials. There are many factors to be considered in making the summer application. Caution should be exercised to prevent coarseness in Valencia oranges. With the rapid flow of sap at this season, it is quite easy to over-fertilize Valencias, consequently the grower must guard against heavy application of organic fertilizer that soon becomes available with high temperatures and the summer rains. Valencias fed too well in the summer seem to split more than trees moderately fed. A very successful grower recently outlined his idea and method of feeding Valencia oranges. He applied about one-third of the total application in the summer, and the other two-thirds in the fall. If conditions warrant, a light top dressing is used in the early spring. I believe cultivation, especially in excessive form will have more influence on coarsening Valencias in summer and early fall especially, than fertilizers will. It is generally understood by some growers that winter and early spring applications will tend to coarsen Valencias, but I believe with the modified cultivating program there is little to fear from that angle.

Another important angle to consider in the summer application, is the time of maturity. Early varieties of grapefruit and oranges should be fertilized in April, and not later than the first of May. This gives the trees available plant food to develop the summer growth normally, and push the size of the fruit in its early stages. Late fertilizing keeps the tree feeding and growing in the early fall just when the grower is testing fruit every day, trying to find a block of fruit to pass the acid test. Early maturing trees should begin to break in August, and show a decided rest period in September and October, if the grower expects to ship early. I have seen early grapefruit maintain a dark green color right up to December first, and the grower never picked a single box of fruit before the maturity test went off, while this same grove handled differently the season before, had the crop picked in October.

You know there is lots in the way you train your trees to behave. Early fall fertilization, followed with cultivation and irrigation in December and January, play an important role in bringing on early bloom. Then real early spring and summer fertilizing is necessary. Soon after the summer fertilizer is applied, lay the grove by, and give way to an early start of the cover crop, which may be mowed from one to three times, all of which will have its influence on early maturity. I know, for I have tried this program. The State research workers have found an abundance of stored up available phosphoric acid in our old groves, and growers have had a tendency the last few years to leave out all or a part of the phosphoric acid, believing they had a sufficient amount to last for years to come. The fertilizer manufacturers have recognized this fact, and have cut down on the percentage of phosphoric acid in their standard mixtures. But I have checked with growers recently where the phosphoric acid was omitted, and find them turning back to the former practice of applying phosphoric acid at least once a year, and most cases twice a year. Phosphoric acid is necessary for coloration of the fruit. Where the phosphoric acid was left off for one year, a packing house manager of one of our leading citrus packing houses called the growers in to let them see their fruit would not color properly. These are some of the cases you heard about the grower having his fruit cooked in the coloring rooms before taking on shipping color.

If growers are working for early maturing fruit, by all means use normal amounts of phosphoric acid. It plays its part in forming and maturing seed, and when seed matures in a fruit, or what not, then and not until then do we reach maturity. These same soils no doubt show an excess amount of phosphoric acid, but it must be locked up, and not always available.

There is too great a variation in the ratio of potash to ammonia. Where ten to twelve per cent potash is used, especially with heavy crops of grapefruit, there has been a complete breakdown of the trees, loss of branches, small, unsalable fruit, and a hardening of the trees that has taken much time and money to correct. Heavy crops demand higher amounts of ammonia, and less potash than is used many times. A large

crop always makes quality fruit. From the Lake Alfred Experiment Station work on potash, and the results observed in the field, it seems like five to eight per cent potash is about right. However, there are cases where the use of ten per cent potash is justifiable. Light crops, and trees bordering on dieback are benefitted by extra potash.

All varieties of citrus fruits carrying lots of seed, require more fertilizer than seedless varieties. This is very noticeable in the amount of fertilizer required for Marsh Seedless and common grapefruit, while the same holds true in feeding Pineapple and Valencia oranges. As a rule, common grapefruit require at least fifty per cent more food than Marsh Seedless, and the same increase for Pineapple oranges over Valencias.

Our attention has recently been called to the practical use of rare elements and secondary plant foods most essential in promoting plant growth and renewing exhausted soils, viz., mangesium, manganese, sulphur, copper, iron, calcium, etc.

Poor conditions in many groves over the state, has called for considerable soil testing work. On the East Coast, soils are too alkaline, and good results have come from the use of manganese sulphate, using ten pounds per tree for bearing trees, during the year, applied in two applications. On the other hand, soil test made in other parts of citrus Florida show too much acid, and lacking in sufficient calcium for satisfactory growth. A satisfactory pH for citrus ranges from 6 to 6.5 and maybe some higher, while some of the bad looking groves are running a pH down to 4 to 4.5, a condition entirely out of balance for good fertilizer reaction.

It takes time and money to correct such a condition. In the first place, it calls for a check-up on the cause. With normal rainfall, and favorable moisture, this condition is not so pronounced. But with dry soils, we get an accumulation of acid materials that soon become concentrated and toxic. In correcting such soils, very good results are being obtained by applying a soil conditioner like hardwood ashes, or some other form of calcium carbonate and active lime to counteract soil acidity and bring up the pH value to the more favorable standard. I might add that it is very necessary to maintain a sufficient amount of calcium in our soils, in our fertilizing program. These soils as a rule are deficient in humus and bacteria. Here is our need for cover crops, heavy mulching of the tree or the use of organics in many forms. Acid-forming fertilizer materials should be omitted on acid soils, or combined with materials that will give neutral reaction.

Liberal amounts of castor pomace or tankage applied well up around the tree, and lightly worked in, hastens root development and new growth. A prominent grower was asked the question, why are you using fertilizer carrying fifty per cent of the ammonia from water insoluble organics? Thought you were sold on mineral fertilizer. The answer was, yes, I was but when groves adjacent to mine, receiving part of the ammonia from organic sources, stood the drouth much better than mine, I decided I had been a fool long enough, and was man enough to acknowledge the all-mineral fertilizer program just wont work in all groves at all times. And the question of cultivation came up at this time. Why, you have been a strong believer in non-cultivation. Why have you started the harrow in the grove? For the same reason; my neighbor who has followed a modified cultivating program, came through the dry period in much better shape than I have. So there you are. We just don't have a cut and dried program to follow in fruit culture here in Florida. What is good one year, may be all out of line the next year. Mineral or inorganic fertilizers, non-cultivation and the mowing machine will work on some soils for a time if moisture is ample, but with long dry seasons, we can't depend on this kind of a program.

Cultivation has its direct relationship to tree growth. We mulch and stir the soil around young trees to produce growth, and there is no good reason for not believing the same holds true with bearing trees. Excess cultivation has proven a detriment. But when thousands of growers still practice shallow plowing or discing in

the fall, followed by harrowing occacsionally during the winter and spring months, convinccs me some cultivation is beneficial. This system has been clearly demonstrated during the last few months to be worth while.

An even distribution of fertilizer over the entire feeding root system can't be over emphasized. My attention has been called to groves where ample plant food was applied, with no apparent results. The fertilizer was applied beyond the root system. It is pretty easy to ring forty pounds of fertilizer around a large bearing tree just outside the branches, and so often this way of scattering fertililzer results in a severe case of frenching, or some other disorder. The average tree, bearing or non-bearing, should have at least one-third of its food applied under the branchces, and two-thirds from the branchces out. One-third to one-half the feeder roots can be found under the branches of a healthy tree. Cover the entire root system with fertilizer. Complete fertilizers can be more uniformly distributed.

In conclusion, I wish to stress the importance of following a systematic fertilizing program, using reliable standard mixtures in the fall, spring and summer. Recognize the value of a live soil by constantly adding humus and bacteria. Keep a constant pH condition in the soil, use common sense in the culture of citrus, and let your trees be happy.

FURTHER STUDIES ON THE HYDROGEN-ION CONCENTRATION IN CITRUS GROVE SOILS OF THE RIDGE SECTION

Dr. B. R. Fudge, Assistant Chemist, Lake Alfred

In the summer of 1930, we had the privilege of making a general survey of the H-ion concentration existing in grove soils along the ridge section of the State. The primary object of the survey was to learn the approximate pH existing in soils of that section. A majority of soils examined at that time indicated an H-ion concentration of slightly less than pH 5.0. Some tests were made in groves that had been limed too heavily fifteen or twenty years ago. These tests showed that the soil was still much less acid than the average and that the trees, likewise, had not fully recovered from the effects of the lime treatments.

At this time, I shall present some information that we have obtained during the past year on the effects upon the H-ion concentration which one may expect after applying certain materials to grove soils; also, some observations upon the tree condition. It should be pointed out, however, that tree response under the extreme drought conditions may not be indicative of the response one would obtain with average rainfall conditions.

Since May, 1930, we have been able to follow very closely the change in H-ion concentration produced in the soil by applications of calcium carbonate in the form of Ocala limerock screenings. With the co-operation and assistance of Mr. C. G. Bouis, this study is being made upon the Wilson grove, which lies about five miles west of Fort Meade. It is doubtful if one could find another grove in the entire State where so much lime has been used recently.

This grove received, prior to May, 1930, some basic materials. In November, 1927, about 1200 pounds of finely ground calcium carbonate was applied per acre. Also, basic slag was applied at the rate of about 1000 pounds per acre in 1929. Thus it should be remembered that at the time of the first tests, May 14, 1930, the soil had already received treatments with basic materials. Since May, 1930, the grove has received two applications of lime of 2200 pounds each, the first in October, 1930, and the second in May, 1931. It may be mentioned here that this grove soil is heavier and of finer texture than the typical sand ridge soil. It has a higher water table and

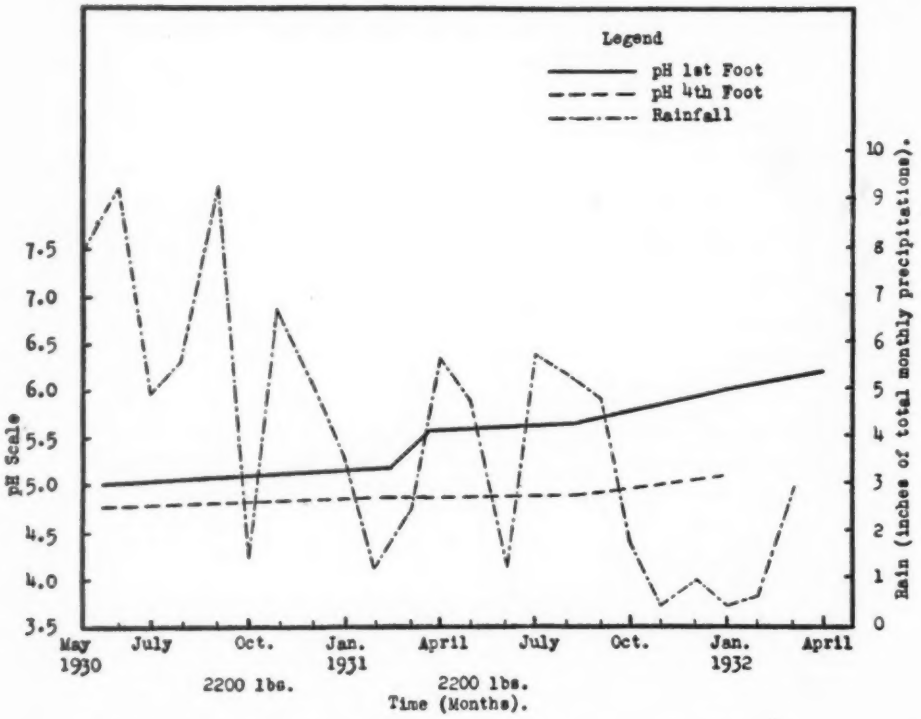


Figure 1. Chart Showing Change Produced in the Reaction of Grove Soil by the Application of 2200 Pounds of Calcium Carbonate in October, 1930 and again in May, 1931.

perhaps contains considerably more organic matter than the higher sand soils.

I have arranged the entire data on a graph as shown in Figure 1. The pH values given in this graph have been calculated from the average concentration of H-ions expressed in moles per liter.

These curves show definitely the decrease in the H-ion concentration with time and with further applications of lime to the soil. Just how much further the curves will rise, due to the action of the lime already applied, is problematical and can only be determined by continuing the tests we have begun. The lime, of course, has had its greatest effect in the surface foot of the soil, since the difference in H-ion concentration is greater now than in May, 1930.

You will note that on May 14, 1930, the difference in the reaction at the two levels was about 0.2 pH, whereas on December 22, 1931, the difference was about 0.9 pH. Such a wide variation as this usually indicates that a large quantity of basic material has been applied to the surface of the soil. Due to the dryness of the

surface soil, it was impossible for us to obtain the fourth foot sample on April 13, 1932. The difference in reaction between the two levels at this time is perhaps greater than one pH. Since Ocala limerock screenings were used, it is quite probable that the reaction will continue to rise, due to the continuous action of larger particles of lime. According to Mr. Bouis, the mechanical state of the material varied from that of the size of a pea down to a fine powder. The greatest change in the fourth foot has occurred since August 17, 1931. If the downward movement of the lime is affected, the curves will tend to converge again at the higher level and approach a relationship to each other similar to that which existed in May, 1930. It is conceivable that they may even cross if acid residual substances are applied in large quantities to the surface of the soil. However, proof for this statement must remain for the future.

We are unable to observe any detrimental effects upon the trees which may be ascribed to these applications of lime. The grove has suffered so severely from the recent prolonged drought that either beneficial or detrimental effects of the lime is overshadowed by a lack of water. The grove at this time is in a poor condition, having lost considerable of its foliage. A great deal of the bearing wood is dead.

The trees are blooming heavily and do not seem to be in any worse condition than those elsewhere in that section. The rainfall curve, Figure 1, shows the small amount of rain that has fallen over the period since September, 1931. The curve shows that about seven inches has fallen since September. This is considerably below the normal precipitation for this period. The precipitation over the same period last year was about twenty inches.

Professor Drew has made some interesting observations upon his groves that were limed about twenty years ago. These observations indicate that we may obtain better results with less acid soil conditions. The H-ion concentration in the unlimed soil is about pH 4.5 and there appears to be considerable dead wood present. The foliage of the trees on this soil is sparse and of a bronze color. The trees on the limed soil have more foliage which is of a healthy green color. The reaction of these soils is about pH 5.0. This difference in condition is apparently due to substances which compose the soil solution and give rise to the greater H-ion concentration in the unlimed soils, since the fertilizer and cultural treatments have all been alike in recent years. Thus, the soils that were lime are now quite acid but not so acid as the unlimed areas. And the trees which at one time were almost killed by too much lime are now in a better condition than those which have never received any lime. A favorable soil condition evidently has been in existence for quite some time in order that the improved appearance of the trees in the limed soil may be so readily observed at this time.

Member: Hasn't he used considerable quantities of stable manure?

Speaker: He has used it to lower the reaction of the soil, yes.

There is unquestionably an optimum H-ion concentration for citrus growing in the ridge soils. The majority of plants grow best at pH 6.0 to 6.5 in heavy loam soils containing considerable organic matter. I do not know where this optimum range of pH is located as regards the sand ridge soils. It can be learned only through very carefully conducted experiments. It would not necessarily be the same as those existing elsewhere in the State because of the variation of the materials in solution.

It has been established by those studying plant nutrition that differential absorption of ions by plants occur, and as a result there is a change in the pH of the nutrient medium. Under alkaline conditions, the change is toward the neutral point, whereas under extremely acid conditions, it is towards a less acid condition. Thus the pH is always a function of the ions in solution and the pH change is affected by the differential absorption of ions by plants. When the plant is grown under field conditions, the complexity of the problem is further increased by the buffering and solvency action of the soil. The differential rate of absorption of ions varies also with the age of the plant. Thus it appears that the

most we can do is to maintain a more or less definite range of H-ion concentration by the use of acidic and basic materials.

Practically everything that is added to the soil affects the H-ion concentration to some extent. There are a number of materials which may be used to greatly decrease the acidity; namely, limestones in various degrees of fineness, hardwood ashes, basic slag and the raw phosphates. These are materials that can be used in considerable bulk. In the application of bulky materials, the degree of fineness is an important factor to consider. The finer the particles of material used, the sooner will the complete effects be observed. In the case of coarse materials, the effects are slow and incomplete, there being a tendency perhaps to use too much material. Thus hardwood ashes and basic slag are to be preferred to the coarser limestones where a definite degree of change in reaction is desired. Finely ground limestone will act more like the ashes and the slag.

Such basic nitrogen carriers as sodium nitrate, calcium nitrate and cyanamid will more or less maintain, under present grove practices, the H-ion concentration at about the same level, as that found in wild or virgin soils, about pH 5.2. They can scarcely be expected to decrease the H-ion concentration of the sand soil above pH 5.3. Ammonium sulfate has an acid residual effect in the soil. However, when used on acid soils like those we have in the ridge section, it does not increase the H-ion concentration to the extent that some would have us think. The experiments at Lake Alfred show, after a ten-year period, that the H-ion concentration is only about pH 0.5 lower in the ammonium sulfate plot than in the sodium nitrate plot. Of course, if the reaction of the virgin soil at the beginning of this experiment had been pH 6.0 or 6.5, the applications of ammonium sulfate might have been much more effective in increasing the H-ion concentration of the soil solution over this ten-year period.

Since the ultimate aim of decreasing the H-ion concentration of grove soils is to improve the quality of the fruit and lengthen the life of the tree, and since we know that excessive applications of lime are detrimental, we should act slowly in changing the pH of the soil. Until we can establish as a fact the contention that a reaction range of pH 5.5 to 6.0 has improved the quality of the trees and the fruit over that which is now obtained at about pH 5.0, and that this reaction can be maintained in general grove practices, one should not make large applications of lime.

Recently our attention has been called to the effects produced by the application to groves of fruit residues, particularly grapefruit, from canning plants. A tangerine grove belonging to Mr. J. W. Sample, of Haines City, Florida, has suffered considerable injury from the improper handling of this material. The injury was manifested by the dropping of leaves and dying of roots in the soil underneath the place where the load of residue was dumped. The material was permitted to remain in a heap for about one week before being scattered. Not only fibrous roots were killed, but also those which were as long as one-quarter of an inch in diameter.

Investigations were made upon the soil acidity resulting from this treatment which, at the time, covered about five acres of a tangerine grove. The soil underneath where the load was dumped about ten days previous to our visit showed pH 4.0; while the reaction near the tree where no residue was placed showed pH 5.0, a difference of one pH. Where the material had been scattered, or had been on for a longer period of time, this difference was not so great. In fact, tests that were made on the areas where it was first applied to the soil, showed the reaction to be about pH 1.5 less acid than where no residue was scattered. The residue, as it arrived at the grove and was dumped, showed pH 3.9.

Total acid determinations were also made upon the same soil samples, using one hundred cubic centimeter aliquots of an extract with normal potassium chloride solution. The total acid concentration was about ten times greater in the soil underneath the places where the material was placed than in the other areas.

In the part of the grove where the material was first applied and the pH found to be high—about 6.5—the total acids were even lower than in the check samples. In other words, the pH determinations and total acid titrations show about the same thing; namely, a very high acidity at first, followed by a gradual decrease until a lesser degree of acidity exists than in the untreated areas. This indicates that the residue is basically less acid than the soil upon which it was placed.

While taking the samples for acidity studies, it was observed that the soil underneath where the residue was dumped was much warmer than that of check area out near the trees. Thermometers were placed in the soil to a depth of eight inches and the exact temperatures were obtained. The check soil showed a temperature of about 21° C. (68.2° F.), whereas the temperature of the treated soil showed 35° C. (95° F.), 14° C warmer. The presence of citric acid and the formation of acetic acid no doubt are the causes of the high acidity found in the soil. The oxidation of the sugars and acids accounts for the higher temperature of the soil underneath the treated areas.

Since making these tests, a number of growers have been consulted who have used canning plant residues on their groves. Practically all of them have observed similar injurious effects where too much was applied at one time. All stress the fact that the material should be scattered immediately after being dumped on the soil and that about one truck load should be applied to the equivalent space of four trees. The material was being applied on the grove belonging to Mr. Sample at about the rate of one truck load to the equivalent of one to two trees. Growers are of the opinion that this material is beneficial when properly applied.

CITRUS EXPERIMENT STATION,
LAKE ALFRED.

SHOULD THE MOVEMENT OF CITRUS FRUITS OUT OF FLORIDA BY TRUCK BE ENCOURAGED OR DISCOURAGED?

R. P. Burton, Leesburg

One of the most serious problems confronting Florida today is the transportation of citrus fruits from the state. Trucking is no less serious in many other states.

Prior to three years ago, it was common to see in citrus Florida great piles of fruit dumped from the packing house; fruit that was unfit for shipment, or fruit that could not be put in containers and sold in the markets for enough to cover the expense.

These cull piles were subjects of comment by visitors, who thought it a great waste. A few trucks owned by home people began to take this low grade fruit, which was unsuited for market and which could not be handled profitably, trucking it to upper Florida and southern Georgia, peddling it to small retailers and commissaries in sawmill camps.

In the season of 1930-31, Florida had a very large crop of citrus fruit, a very large percentage of which was small, which could not be put in containers and shipped to market profitably. Trucks began to flock in from all parts of the country to buy this fruit at low prices and soon put the wholesale fruit and produce dealers out of the Florida citrus fruit business.

Many of these trucks were not interested in the profit to be made in merchandising this fruit, but were interested in its transportation. In some instances they were satisfied if they got the cost of the fruit back and pay for transportation out of the added prices on delivery.

This procedure soon affected all of the markets in the cotton states and even beyond. It brought about a low level of prices and educated the public to Florida citrus fruits at a price that was destructive to the industry. The public will buy any commodity which they use

as cheaply as they can and when a low level of prices is established, it is impossible to raise it otherwise than by discontinuing the supply.

When these trucks could not sell to the wholesale people, who had already supplied their needs from other trucks, they would go to the retailers and from them to the so-called "curb markets," where the fruit was peddled along with other farm products of every character, from greens to fence posts. That was lots of fun for the people who could buy our oranges and tangerines at $.75 to $1.25 per bushel and our grapefruit at from $.50 to $.75 per bushel. In practically every city south of the Mason-Dixon line can be seen these "curb markets," where our citrus fruits can be bought from these truck peddlers, at prices that make the heart of the citrus fruit producer sick.

Discussing the question of the cost of transportation with a number of these truckmen, in a recent three months' survey from Richmond to Taxarkana, and south of that line, I found but one who admitted that he took account of the depreciation of his truck.

In every state in which I made inquiry, there is a law that permits a farmer to peddle the produce from his farm wtihout interference or taxation of any kind. The truckmen were quick to provide themselves with certificates, obtained where they could, that the fruit they were offering came from their own groves. There is a provision, I think, in the state laws that any ex-service man who is partially disabled enjoys the same privilege. In some instances, it is said, some of these truckmen employ such ex-service men to ride with them who claim ownership when questioned.

The net result of this trucking is that there is practically no business done by wholesale fruit men in Florida citrus in any territory reached by these peddling trucks. This applies also to green vegetables from Florida, Georgia, the Carolinas and other states as you advance up the Atlantic seaboard. In consequence, many jobbers are either forced out of business or have lost heavily and are struggling for their existence by handling other commodities which are out of reach of the trucking peddlers.

Modern merchandising in perishables necessitates equipment of plants with refrigeration where such commodities can be preserved in storage from deterioration and decay which they would suffer without such cold storage facilities. There is great unrest among these wholesale fruit and produce dealers and naturally they are disinclined to junk their plants at great loss to themselves.

They are, throughout the country, forming associations among themselves and securing legislation looking to the control of this trucking problem. Such a law was enacted in a recent session of the Tennessee legislature, embodied in the following amendment to their revenue bill:

"Each person, firm or corporation engaged in the business of running a wagon, truck, auto or other vehicle, and who sells and delivers fruits, vegetables, nuts and produce (where it is not produced or raised by the vendors or seller), candy, cigars, cigarettes, tobacco and drugs, or merchandise, is declared to be a peddler and as such shall pay for each wagon, truck, auto or other vehicle in each county per annum $100.00. (This tax is not to be paid for a period of less than one year.)

"The Commissioner of Finance and Taxation shall especially charge the State Highway Patrolmen to prevent unlicensed peddlers from operating within the state."

A peddler must, if he goes into Tennessee, pay to the state $100.00 license, to each county in which he peddles $100.00 license and in each town another license, making a total, generally, of $300.00 in the first city that he visits and $200.00 in each subsequent county and city. Other states are gradually enacting similar laws.

While this trucking out of Florida has practically destroyed the market, in a very large part of this country, for our citrus products, except at prices that are ruinous to producers, there is yet another feature that is just as serious. Many of our counties have bonded heavily to construct good roads. These roads are built of light material and for light traffic. They were never intended to carry such loads as are carried over them in these trucks. These bonds extend over a long period of years. The property owners

are taxed beyond their ability to pay to meet the interest and sinking fund on these bonds. The roads are rapidly being destroyed, and long before the bonds can be paid the roads will have been destroyed and the various counties owing these bonds will not be able to get further money with which to reconstruct them.

In an interview with Mr. Mayo in Tallahassee the latter part of December, he stated that he had kept inspectors on the highways who had kept a close tab on this and he knew they were carrying out forty-five car-loads of citrus fruits per day, and that the week before he saw me, a truck left a packing house in Polk County with 504 boxes of citrus fruits in the truck and trailer.

The trucks are with us to stay. As long as we will permit them to travel our roads, and the truck manufacturers and sales agencies will sell trucks at a small payment down, and the gasoline stations dot our highways, they will be here.

Viewing the proposition as set forth above, steps must be taken to regulate and control the trucks. Just how it can be done must be worked out. With the tremendous taxes that we have to pay, the citrus fruit producers must receive a fair compensation from their products or they must go out of business. It is the duty of the state to devise ways and means by which our citrus property and our highways can be protected from this destruction.

In discussing this matter with the manager of one of the largest shipping interests in California, he states that they are having this same trouble, and that trucks are taking oranges from Southern California to El Paso, 600 miles, and as far as St. Louis, which must be nearly 2,000 miles and that these truckmen frankly admit that if they can break even on the fruit they are satisfied to take the cost of transportation.

This is not solely a Florida proposition. Every state in the union today is confronted with this condition. Trucks are taking cotton from the banks of the Mississippi and transporting it to the mills in the Carolinas. They have brought the railroads to their knees. We see railroad stocks such as the New York Central, the Pennsylvania and the Atlantic Coast Line and many others, that not far back were selling at from $1.75 to $2.25, today selling at from around $.16 to $.25.

A small percentage of our citrus fruits goes out of the state by truck. That small percentage has destroyed the markets for our fruit. When I began a survey of this truck situation, in November, I left Florida with the feeling that the trucks had been a great blessing to us the season previous. It took but a few days to convince me of the error of that feeling. I can see every reason for discouraging the trucking of our fruits out of the state and I can see none for encouraging it.

SOME PROBLEMS OF THE PECAN GROWER

G. H. Blackmon, Pecan Culturist, Experiment Station

The problems of the pecan grower are many; in fact, they are too numerous to permit a full discussion of them all in the time allotted for this paper. Therefore, only a few of the major ones will be considered.

According to data obtained from U. S. D. A. Bureau of Crop Statistics, the average annual production of pecans in Florida is about 1,400,000 pounds, considering the years 1924 to 1931, inclusive, with an average yearly value of about $350,000. The 1931 yield was the largest of record, being given at 2,200,000 pounds, although many of the nuts in the central northern Florida district were of very poor quality, due to the excessive deficiency of rainfall in that area during the critical period of nut development and maturity and the fact that many trees were carrying great quantities of nuts. However, the quality was good in areas where the moisture supply was fairly adequate. Due to unfavorable

market conditions over the United States this crop of 1931 had a value much lower than each of the previous years since 1924, except the light crops of 1929 and 1930.

There are approximately 100,000 pecan trees in Florida of all ages, varieties and types, with less than half of this number of bearing age and many in neglected developments, so it will readily be seen that the yield per tree of cultivated orchards is much better than an examination of the statistics would indicate.

The very high tree yields and prices of nuts anticipated in the early days of the industry did not materialize as was expected. It is true that there were and still are many records of high-yielding trees, and prices, during the period over which the pecan industry has been developing, have been good. But with a heavy planting of named varieites over the pecan producing area in the South, notably, Georgia, Alabama, Mississippi, Louisiana, North and South Carolina, and the top-working of many thousands of trees throughout the native seedling belt of Texas, Oklahoma, Arkansas, and Louisiana, the production has been on the increase and the price has gradually declined until 1931 when the new low level was reached for named varieties. Although the prices during the period immediately preceding 1931 were slightly declining, they were sufficiently attractive to encourage the planting of trees in large numbers and closer attention was paid to the harvesting and saving of the large seedling crop over the entire native area as they could be sold at a higher price than ever before. Consequently, the production of pecans in the United States has been on the increase until now in peak years, such as 1926 and 1931, the total yield amounted to about 83,000,000 and 74,000,000 pounds, respectively.

In addition to the larger quantity of pecans, the production of other nuts has constantly increased. The average annual production of various nuts in the United States, as shown in U. S. D. A. Statistics, are given in Table I.

TABLE I

AVERAGE ANNUAL PRODUCTION AND IMPORTATION OF NUTS IN THE UNITED STATES

Pecans	40,000,000 pounds
English Walnuts	61,000,000 pounds
Almonds	23,000,000 pounds
Peanuts	750,000,000 pounds

IMPORTS OF NUTS INTO UNITED STATES

Brazil Nuts	31,000,000 pounds
Chestnuts	22,000,000 pounds
English Walnuts—	
Unshelled	21,000,000 pounds
Shelled	20,000,000 pounds
Almonds—	
Unshelled	2,000,000 pounds
Shelled	18,000,000 pounds
Filberts—	
Unshelled	11,000,000 pounds
Shelled	6,000,000 pounds

All of the peanuts cannot be considered as being in open competition with pecans but, nevertheless, a very large percentage are used in various ways for human consumption which amounts to many millions of pounds annually. Considering production and imports, including pecans and other tree-borne nuts, there are about 250,000,000 pounds to be consumed annually besides peanuts, which will probably amount to at least an equal quantity. Thus, it will be seen that there is an annual supply of less than three pounds of nuts per capita and, if a like amount of peanuts reach the consumer, it is still less than six pounds. When pecans alone are considered the average annual supply on an unshelled basis is only about .36 of a pound per capita. However, where they come in competition with supplies of other nuts that have been selling at a much lower price it is readily seen that there is a very serious marketing situation confronting the pecan growers.

Table II, giving the per capita supply of specified nuts from 1924-25 to 1928-29, is taken from Table 16, U. S. D. A., Bureau of Agricultural Economics, Marketing Pecans, A Preliminary Report, September, 1929, and is copied here.

TABLE II

PER CAPITA SUPPLY OF SPECIFIED NUTS (UNSHELLED BASIS) IN THE UNITED STATES, 1924-1925 TO 1928-1929

Period	Pecans	Almonds	English Walnuts	Brazil Nuts	Filberts	Chestnuts	TOTAL
1924-25	.20	.79	1.14	.28	.16	.25	2.82
1925-26	.26	.69	1.25	.25	.22	.20	2.87
1926-27	.55	.72	.89	.35	.17	.22	2.90
1927-28	.19	.71	1.26	.10	.22	.09	2.57
1928-29*	.36	.75	.93	.31	.21	.17	2.73

*Preliminary

From a study of Table II and from the experience of the growers in trying to effect a satisfactory disposition of the 1931 crop, it is apparent that one of the great problems of the pecan grower at the present time in connection with marketing is a proper distribution of the product. As a possible solution to this problem there are two co-operative marketing associations in operation. The National Pcean Growers' Exchange, with main offices at Albany, Georgia, has been in existence for a number of years. Then, in 1930, the National Pecan Marketing Association, with headquarters at Jackson, Mississippi, was organized under the Federal Agricultural Marketing Act and set up locals in different sections of the pecan producing area of the United States and was ready for business in the fall of that year. There are, of course, many millions of pounds of nuts marketed through private dealers, commission houses, cracking plants, and to special mail order trade. It is to be hoped that it will be possible to more equitably distribute and market pecan nuts in future years than it has been in the past. It would seem, therefore, that if marketing contacts were properly made and kept from year to year that it would be possible to greatly increase the consumption of pecan nuts as there are many markets in certain parts of the United States, notably the middle west and north west, that have not been fully worked and there are many people who are not familiar with the high food value and excellent quality of the pecan. Therefore, by co-operative marketing it ought to be possible to reach those sections of the United States that are not touched at the present time, thereby increasing consumpion tremendously.

There is not a food product that can be carried from one year to the next in cold storage to better advantage than can the pecan. It is possible to carry the nuts from one crop year into the next in a fresh state, if they are in good condition when placed in cold storage and if held at the proper temperature and humidity. This is very advantageous in building up markets as, by handling nuts in this way, it is possible to have them in a fresh condition at all times to supply the trade.

An outlet for pecans that is constantly increasing is that to the commercial crackeries throughout the country. They supply the baking, ice-cream, confection, and other industries with kernels, or pack them in containers for the retail trade. Some of the large plants of this kind in the United States purchase annually several hundred carloads of pecans each, while there are a great many that crack annually from a few thousand pounds to a million or more.

However, through all the fog of the marketing troubles that the pecan grower has just been passing, there can be seen a ray of light that is encouraging. With prices being the lowest since pecan growing became one of the important horticultural industries of the South, more nuts have gone into mass consumption than ever before. Even though purchasing power has been low, the price of nuts has been down to such a level that many have purchased pecans in sufficient quantities to learn of their high quality. Therefore, when economic conditions return to normal there should be a greater demand for nuts of this type than there has ever been in the past.

Besides the marketing problem of the pecan grower, there is that of economical production of nuts. In the early stages of the industry there were many orchard developments in certain parts of north Florida that were planted to sell in five and ten-acre units. When these plantings

were made there was very little information about the behavior of varieties. Consequently, many were not of productive sorts, some due to the inherent characteristics of the variety to be a shy bearer, to be susceptible to pecan scab, or to produce nuts of poor filling quality, while others were not planted on soils that are suited to pecans. These orchards, in most instances, are not being cared for as they should and therefore are not in quantity production, although the trees are of sufficient age to give heavy yields. Therefore, the production in Florida is very much lower than it would be if these trees had the same producing ability as those in many of the smaller orchards on farms where some kind of orchard management is practiced. One of the problems in Florida, therefore, is to know just what should be done with such orchards that are not profitable. One of the most practical procedures would be to select the locations where the soils are such that good trees have developed, top-work the undesirable ones, and put into operation a program of orchard management that would result in profitable nut production. The sections where the soil has failed to grow good trees should be cleared of them and the land utilized for other crops.

It is necessary, in preparing a paper of this kind, to at least include a brief discussion of soils. The pecan is indigenous to the well-drainied, fertile, alluvial soils of the lower Mississippi River valley and its tributaries and those of the rivers of Texas and Oklahoma. In these areas there are great quantities of seedling nuts harvested annually that are placed in the markets from which the commercial crackeries get most of their shelling stocks. Some of the soils in Florida that have been planted to pecans are not suitable to a profitable crop production and others have not been cared for in such a way as to encourage adequate tree growth and yields. The soils through north and west Florida that are best suited to pecan growing are those that are well-drained yet have a high hygroscopic moisture-holding capácity. Such soils permit adequate root development and readily respond to a program of maintaining fertility.

Organic materials are an important soil constituent in connection with the growing of pecans in Florida. It is therefore necessary to add lot manures or grow and turn under cover-crops in addition to applications of commercial fertilizers, if the best results are to be had. Since many farms do not have sufficient livestock to produce manures in large enough quantities for their orchard soils, it is necessary to resort to cover-crops to supply the organic matter. These can be grown in winter and summer. The common practice in Florida is to set the trees and grow some other crop between them until they are of such a size as to interfere with the intercrop. In growing corn it is possible to produce large quantities of material to be returned by planting velvet beans and plowing under the entire crop after the corn has been harvested. *Crotalaria spectabilis* can be grown satisfactorily in connection with corn as well as some other crops. After the trees have reached a size that the top branches cover a large portion of the area, all the space should be given over to them and the growing of cover-crops for soil building purposes. Kudzu is being used by some growers as a summer cover-crop and seems to be very promising in the program of maintaining soil fertility and, at the same time, permit the cutting of at least one hay crop each year. In growing Kudzu, each tree in the orchard should be visited every ten days or two weeks during the growing season and any vines that have become attached to them should be cut, as this is a very rank grower and will cover the trees in a short time if not watched. In addition to the summer practices there are several winter cover crops that can be grown in Florida. Oats, rye, Austrian winterpeas, and hairy vetch are good ones to use. Hairy vetch usually gives the highest tonnage of green material to return to the soil, although some years Austrian winterpeas do about as well. Being legumes, these last two crops gather nitrogen from the air which is turned into the soil along with the organic material. Vetch and peas can be planted with either oats or rye and grown in this manner but such a practice is not necessary.

Soils in which pecan trees are growing should receive a commercial fertilizer in connection with

cover-crops to get the best results. Where the winterpeas and vetch are grown each year a good practice is to fertilize this crop with 300 to 400 pounds of superphosphate, fifty pounds of sulphate of potash per acre at the time the seed are planted and, for the first two or three years after beginning such a program 100 to 200 pounds per acre of a good nitrogenous material should be applied in the spring just before the trees begin to force bud growth. When 10,000 to 20,000 pounds (green weight) of vetch or peas are turned into the soil annually, satisfactory tree growth and nut production have been had by using only the superphosphate and potash as indicated.

Several co-operative fertilizer experiments with pecans are being conducted by the Florida Agricultural Experiment Station. The general results of some of them are given in Table III.

ized. However, had it not been for losses due to storms, insects, diseases, and cold, the results might have been different. It should be pointed out here that these results are composite totals of various plots where different fertilizer mixtures are being used and are cited to show that fertilizing is necessary for quantity nut production, as, in most instances, the trees in the fertilized plots gave better results than those in the unfertilized ones. In all the experiments and with all varieties, except the one in Holmes County, the average annual yield per tree of those fertilized was from fourteen per cent to 1160 per cent greater than the unfertilized ones. These results seem to indicate that by proper fertilization and cover-cropping it would be possible to very materially increase the production of pecans to such a point that they would be more profitable than at the present time. The average

TABLE III

RESULTS IN NUT YIELDS OF SOME OF THE CO-OPERATIVE PECAN FERTILIZER EXPERIMENTS BEING CONDUCTED BY THE FLORIDA AGRICULTURAL EXPERIMENT STATION

County	Year Trees Were Set	Variety	No. years Experiment has been Conducted	Average Annual Yield Per Tree		% Increase Fertilized trees over check
				Fertilized (pounds)	Unfertilized (pounds)	
Leon	1913	Moneymaker	8	13.9	12.2	14
Jefferson	1912	Moneymaker	6	53.8	26.6	102
Jefferson	1919	Moneymaker	8	8.9	5.8	53
Jefferson	1919	Moore	8	14.6	6.9	111
Jefferson	1912	Moore	8	23.3	13.4	73
Jefferson	1910	Schley	6	13.5	11.2	20
Bradford	1919	Curtis	8	8.6	4.3	100
Duval	1920	Curtis	7	6.3	0.5	1160
Duval	1920	Success	7	4.7	1.7	176
Holmes	1916	Stuart	8	5.0	5.2	-4*

*Decrease

An examination of Table III, showing the average annual yield per tree of those fertilized and unfertilized, will reveal the fact that there is a very decided advantage in production in favor of the fertilized ones, except with the Stuart orchard in Holmes County, and there are several fertilized plots in this experiment where the trees have materially out-yielded those unfertilannual yield per tree, as shown for the fertilized plots, is sufficiently high to be satisfactory when computed on an acre basis. The averages shown for the trees that were set in 1919 and 1920 are not entirely fair as they have been much greater for the last four years than for the first part of the period considered.

Insect and disease pests cause heavy losses an-

nually, some years greater than others, as at times the entire crop in a certain area may be destroyed by one insect alone, the nut case-bearer. Other insects that take heavy tolls are the leaf case-bearer, the shuck worm, walnut defoliater, fall webworm and black aphid. Pecan scab is one of the common diseases and heavy losses are occasioned annually where susceptible varieties are being grown. Leaf spots of various kinds, sometimes cause defoliation, thus weakening the trees. Spraying with Bordeaux mixture is the control method recommended for all these diseases by the Experiment Station pathologists. The Assistant Entomologist, Fred W. Walker, in charge of Pecan Insect Investigations, recommends lead arsenate sprays for all the insects except the black aphids, which can be controlled by the use of nicotine sulphate, and the shuck worm, which is controlled by destroying or plowing under the shucks. However, on account of the eating habits of the nut case-bearer, other methods of control will have to be worked out and it is encouraging to know that progress is being made.

There are several varieties that are practically resistant to pecan scab and these are the ones that are being planted to a large extent, because they do not require spraying with Bordeaux. The variety problem is an important one and should be studied very carefully by the prospective planter or purchaser. Varieties can make or ruin a pecan orchard, so far as nut production is concerned.

In conclusion, it is well to point out that the pecan industry is not one that will permit the owner of an orchard to do nothing towards providing suitable conditions for adequate tree growth and nut production and in seven, eight or ten years just sit back and gather in the "golden fleece." However, along with the many problems of the pecan grower, there are some bright spots that hold out hopes for the orchardist. If an orchard is properly located as to soils and cared for as it should be, as well as being composed of suitable varieties, it will show a profit during normal times. The pecan is and will continue to be an important horticultural crop for north and west Florida.

CULTIVATION, COVER CROPS AND MULCHING OF CITRUS TREES

Paul M. Hoenshel, Port Mayaca

In attempting to address this meeting I feel very much like a primer scholar called upon to demonstrate a problem for the algebra class and it will take only a very few moments to tell all I know about my subject and most of what I think.

It seems to me that there has been as much difference of opinion among growers regarding the proper practices in "Cultivation, Cover Crops and Mulching of Citrus" as any other phase of grove management. What I have to say applies to the grove I have charge of and may or may not apply to groves located on entirely different soil. I consider mulching a very vital point in making a grove at Port Mayaca, but I distinctly recall several experiments made by growers in the Redlands District of Dade County about seventeen years ago where mulching was a total failure. The groves in question were heavily mulched with prairie hay and for a year or two made more than average growth, but later practically all died during a period of drouth. Examination showed that the roots had grown up into the mulch during normal rains and were apparently unable to reach their usual supply of soil moisture when the rains ceased.

During the past three years I have made a number of comparative tests of mulching and non-cultivation compared with clean cultivation and am convinced that, under our conditions, mulching is essential to the production of a healthy grove. If I were to list them according to my idea of their relative importance, it would

be—Mulching, Cover Crops and Cultivation of Citrus.

The general plan of handling the 500 acres of citrus at Port Mayaca is to mulch each tree as heavily as the available supply of material will permit, grow as much cover crop in the middles as possible and reduce cultivation to a minimum. It has been my observation that a dollar spent in mulching has brought us better returns than a dollar spent in cultivation.

This is a very simple and practical plan, but like most simple and practical plans, has one difficult point. That is, where to get this large quantity of material. A one and one-half ton truck with large rack can haul sufficient dried material to mulch an acre in about eight loads. Multiply this by 500 and you get 4000 loads, which is a lot of grass in any language.

Wild grass makes excellent mulch where a large acreage smooth enough to work with machinery is available without a prohibitive haul. We have used hundreds of loads of sawgrass and found it very good, but hard to handle and growing on soil too wet to work with machinery under average weather conditions. Prunings of Brazilian oaks, which are planted in large numbers for windbreaks, have proved a very good minor source, as the prunings have to be disposed of in some way and they make a very good mulch. A number of experiments have been made with partly dried muck, using from five to ten tons per acre. This has apparently been profitable from a soil improving standpoint where the cost of handling was not too high, but of practically no value as a mulch. If we had them available, we would use large quantities of planer shavings.

The best all around source has been to plant adjoining truck land to Crotalaria during the summer when the land is otherwise idle. The growth was about equal parts Crotalaria, grass and weeds, but the tonnage was good, it was economical to handle and the results in the grove very satisfactory. The main point seems to be to get any organic material which can be had in sufficient quantities and at low enough cost.

I adopted the mulch method because comparative tests showed that the trees did much better with the mulch than without, and these tests have been carried on long enough to be reasonably sure that this improvement will continue. In testing a grove practice, it takes several years to know what the results actually are. In one case I treated forty acres of young grove with an application of muck in addition to the regular mulching. For over a year there was no noticeable difference between these tracts and adjoining ones which had not had any muck, but this winter there has been a decidedly better growth on these tracts for which I can account in no other way.

The fire hazard is something which has to be considered in a discussion of mulching. With us, there is sufficient green cover crop growing practically the year round to prevent any fires spreading, but in some cases piling all this inflammable matter around the trees might be decidedly risky. There are very few grove practices which can be applied to all groves in Florida without first considering the effect of local conditions, and mulching is no exception to the rule.

Parts of our grove are so heavily sodded with Bermuda grass that we have never been able to get any other growth established. However, this has not been the unmitigated nuisance under the mulch method that it was under clean cultivation. Bermuda will not stand smothering and a good heavy mulching will keep it under control for a year with very little attention. We mow the grass whenever it gets thick enough to justify it and rake it around the trees to supplement the mulch already there. The thicker the grass, the more mulch it makes to prevent its own growth around the trees. On parts where Bermuda has not taken the ground to the exclusion of everything else, Crotalaria has been the best cover crop tried. So far, the Striata seems better suited to our conditions than the Spectabilis. It makes a vigorous growth under adverse conditions, and while it has not re-seeded quite as well as we had hoped, on account of a small worm which destroys the seed before maturity, its habit of continuing to grow for several years in spite of repeated mowings has been a pleasant surprise. Our method is to mow rather

frequently, but not cut it too low, and with this treatment it continues to grow and pumpkin bugs have never been a problem.

Cultivation with us depends upon the size of the trees, type of soil and amount of mulch around the trees. It is evident that a heavy mulch will keep down the weeds and grass around the trees much better than a light mulch, and correspondingly reduce the amount of cultivation necessary. What cultivation is done is in the form of light hoeings, from once to three times a year, depending upon conditions. If rains are normal during fertilization, the fertilizer is scattered over the mulch and rained in. If weather is dry, mulch is loosened up with a rake to permit the fertilizer to sift through to the ground.

It is rather hard properly to value a grove practice during an abnormal season. A grower has to be particularly on his guard or he will know something which is not so. It seems that abnormally dry weather is now normal Florida weather, and what a tree would do if it got an occasional good rain is hard to say — probably die from the shock—but from what data I have I consider the best practice for all weather conditions to be all the mulch and cover crops you can get and as little cultivation as you can get by with.

Mr. O'Byrne: What's the type of that soil?—muck land?

Mr. Hoenshel: Part of it is about a flatwood sand land, and part a mixture of sand and muck. None of the grove is on pure muck.

Mr. O'Byrne: How big an area do you mulch?

Mr. Hoenshel: We mulch around a tree, generally figure a spot about a foot from the trunk. We don't have to mulch right around the trunk. We spread about two feet beyond the spread of the branches.

THE DISEASES OF ORNAMENTAL PLANTS

Dr. William B. Shippy, Leesburg

Instead of listing a number of ornamental plants with their respective diseases I am going to assume a hypothetical plant as the typical ornamental, and discuss it from the disease standpoint. Let us say this typical Florida ornamental will be one of the bulb type. It has a seed piece, which in this case is a bulb-like organ; it has one root, one stem, one leaf, and one blossom. Quite a complete plant in every respect, you see. This plant may become diseased in its entirety, or any portion of it may become diseased.

In thinking of it from the disease standpoint, what are the possibilities? First, some disease-causing organism may attack it; second, it may get sick from so-called natural causes.

Among the natural causes may be included wounding or bruising, starvation, poisoning, unfavorable soil, temperature, moisture, or sunlight. Factors like these must not be underestimated in the growing of healthy plants. Some ornamentals are very sensitive about such things; others less so. If one intends to set out ornamental plants, he should carefully consider their individual requirements and select types of plants requiring only such time, effort and expense as he may be able to spare.

Let us briefly consider these growth factors which have so important a bearing on the health of this typical ornamental. Any portion of the plant may be wounded or bruised, but a frequent way this happens is in the severing of roots in cultivation. For instance, I have seen a bed of lilies destroyed by cultivation. A severed root strikes right at the food and water absorption area of the plant. Complete removal of the root system means an immediate checking or complete cessation of growth processes, and for most plants ultimate death would be certain. Shortly following the injury the plant wilts and dries up. Of course, the removal of

a single root in a system of many roots, or a minor injury to any given root, is not usually disastrous, but a proportionate effect is produced. A secondary effect of wounding is the rupturing of external protective tissues of the plant, thereby providing an entrance for disease-causing organisms.

Our typical ornamental may be starved by depriving it of any one of the so-called "essential elements." For most plants there are a dozen or more essential elements, but the ones requiring frequent replenishing are nitrogen, phosphorus, and potassium, or as we usually refer to them—nitrate, phosphoric acid, and potash. Insufficient nitrate results in a pale-colored plant which fails to make a satisfactory growth. While essential to every living cell of the plant, only a very small amount of phosphorus is actually absorbed, and the frequent application of phosphorus is not so critical. Lack of potash results in such effects as reduced growth, "dieback" of terminal shoots, dwarfed bulbs and other storage organs, and sometimes in spotted or blighted foliage.

Many examples of plant poisoning occur to you. Most of the materials which are violent poisons to animals are also poisonous to plants if absorbed. The insecticides and fungicides which are daily used in insect and disease control are also poisonous to the plants which they are used to protect. Arsenicals are one example. The question is sometimes raised as to whether or not their continued use does not result in an accumulation in the soil which eventually proves toxic. I think this is quite a justified assumption. Such compounds are widely used as weed killers because of their high toxicity to plant life. Cyanide compounds also receive considerable use in the control of insects and other animals; these materials are also extremely toxic to plants. In general, our typical ornamental will be destroyed by large doses of almost any soluble chemical, and even minute quantities are frequently fatal. One has only to recall the damaging effect of dilute amounts of illuminating gas on carnations, geraniums, orchids, and many other plants.

The composition of the soil is sometimes very important in influencing the health of the ornamental. Sand alone is a very poor growing medium for practically any plant one might mention. The temperature of sand as well as its moisture content fluctuates too much. Fertilizers wash away rapidly in such a soil, and the quantity of beneficial soil organisms is greatly reduced. Plants on such a soil frequently remain unthrifty despite the fact that other conditions may be optimum. The incorporation of organic matter in the form of humus, leaf mold, peat, muck, manure, etc., is of immense value in making sandy soils suitable for the growing of the average ornamental. The reaction of the soil is worth considering. A few plants like the azalea do best in distinctly acid soils, but a neutral or only slightly acid soil is preferable for most ornamentals. This applies not only to the growing of plants, but also to their propagation by cuttings.

Of all the natural influences affecting the growth and development of this typical plant, temperature and moisture are of first importance. If this ornamental is planted out of season it fails because the prevailing temperatures are too high or too low, or it cannot withstand certain extremes. Depending on conditions, it may shrivel and die immediately or this may take place slowly. In respect to moisture we have certain examples, like the water lilies, which require one extreme, and others, like the cacti, which are favored by the opposite extreme. Most ornamentals do best with a moderate amount of soil moisture, some leaning toward the wet side and some toward the dry. Lacking moisture, our ornamental will wilt and die; given too much water the soil will be depleted of oxygen, and without sufficient oxygen the root system will die and decompose.

With this brief treatment of fundamental growing considerations, the disregard of which results in a very large proportion of plant sickness, we may also briefly consider that great class of diseases in which the plant becomes infected by some disease-causing organism.

Disease-causing organisms are simple plants ordinarily, but since they have no green pigment, are unable to manufacture their own supply of

organic food. Hence, they must secure their starches, sugars, proteins, and fats from outside sources. Some organisms choose one source; some another. We are particularly concerned, however, where a favorite ornamental is the source of that food supply.

In considering these diseases we may simplify the whole proposition by dividing our hypothetical plant into two halves, first considering the possibility of disease to the below-ground portion, and then to the above-ground portion. Below-ground troubles are usually those in which rotting takes place, although sometimes a wilt disease or an overgrowth disease becomes troublesome. Procedures designed to reduce or prevent underground diseases are largely sanitary in character. We have already considered the general make-up of the soil, but there now enters a new factor. How clean is that soil insofar as being free of disease-causing organisms? Any new soil which has not previously been used for agricultural purposes will most likely be clean, and a contaminated soil may be made comparatively safe by sterilization. There are various ways to sterilize it, but a thorough soaking with a solution of formaldehyde in water, 1 to 50, is about as satisfactory as any. This will ordinarily require about one-half gallon to the square foot. Covering the sterilized area with canvas or something similar for the first twenty-four hours will improve the quality of sterilization, and within a week or ten days the area may be safely replanted.

After the soil itself, the next consideration is the possible clean-up of the seed place. Seed disinfection is seldom necessary in the case of ornamentals. In the case of certain fleshy seed pieces, as calla tubers and gladiolus corms, a chemical treatment is now considered advisable. Any seed piece of whatever kind of plant which shows a considerable amount of rot should be discarded, but where there is only a small amount of rot, the injured areas may be cut out. Thereafter, soaking the seed piece in a disinfecting solution will further ensure against spread of the rot. For general disinfection purposes either corrosive sublimate or formaldehyde are good. Corrosive sublimate is ordinarily used at the rate of one to one thousand in water and soaking for two hours would be an average length of time. If formaldehyde is used, a strength of one to fifty is satisfactory and the length of treatment would be one hour. If the treated seed piece is planted immediately, no rinsing is necessary.

Even with a disease-free soil and with disease-free seed there is a possibility of underground trouble. Such treatments are not 100 per cent effective by any means, although their use often means the difference between success and failure. Then, the planted area may become contaminated at any time through the agency of wind, rain, insects, birds and other animals, including man. In the case of tender seedlings or cuttings one must be on the watch for "damping off," although after sterilizing precautions have been taken this is not apt to occur the first year. "Damping off" usually appears when plants are watered excessively and when ventilation is poor. If discovered early it may be checked by watering the bed with a one to one thousand solution of corrosive sublimate and by taking steps to improve ventilation.

In the case of diseases which originate on above-ground parts sanitation is also important. Diseased leaves and stems are the sources from which further infection comes, and it is of the greatest importance that such be removed and burned as promptly as possible. Usually it is not essential that the entire plant be removed and destroyed. A few of our ornamentals become diseased with what is referred to as mosaic, in which case the foliage becomes mottled or yellowed in color, the foliage or blossoms become twisted or otherwise irregular in growth habit, and the entire plant is dwarfed. Such plants in their entirety should be lifted and destroyed. Mosaic is the most important disease of the Easter lily in this state, and by all means everyone who grows Easter lilies should familiarize himself with the symptoms of the disease and promptly rogue out infected plants. The other important step in safe-guarding this typical ornamental against above-ground infections is the use of a fungicidal spray or dust. Fungicides are merely protective coatings, and they must be applied thoroughly to be effective. They usually contain either some copper salt or some form of

sulfur, and are particularly poisonous to germinating fungous spores. Fungous spores which become deposited over the leaves and stems of this ornamental will germinate and enter the plant chiefly during wet weather, and for that reason a fungicide should be applied before rains rather than following. In this way the foliage is protected when there is greatest danger of infection. To apply the fungicide after a rain is about like closing the stable door after the horse has been stolen. Of course, the safest plan for all classes of ornamentals would be to maintain a covering on the plant at all times.

We do not have an ideal all-purpose fungicide. Such a one would be effective against all foliage and stem diseases, would be easily applied, inexpensive, non-injurious to the plant, and undiscernible on the foliage. People in general dislike the liquids since they are comparatively difficult to prepare, messy to handle, do not adhere well to smooth foliage, usually discolor the foliage, and if too concentrated or applied under a bright sun will frequently cause burning. However, lime sulfur solution or bordeaux mixture, if prepared and applied with intelligence, are particularly effective in protecting plants against most kinds of above-ground infections. Because of enumerated disadvantages of the liquids, perhaps the dusts would be preferable for home garden use, at least. Prepared, finely-divided copper-lime or sulfur dusts may be obtained everywhere. They are easily and quickly applied, seldom burn, and have a good record for effectiveness. While adhering well to any foliage they wash away rapidly with rains or showers, and must be replaced frequently. Both types of dust are good for general purposes, but the sulfur dust is much to be preferred in the treatment of powdery mildew.

TUNG TREE CULTURE

H. W. Bennett, Gainesville

Possibly I can best approach my subject by explaining the line of reasoning and conclusions that induced me to plant my personally owned 2,000-acre Tung grove, at *"Tung-Acres,"* situated ten miles due north of Gainesville. This is probably the largest commercial Tung grove in the world being developed according to the highest horticultural standards, and for this I am greatly indebted to the guidance of The Florida Experiment Station and to my competent managerial associate.

It should be borne in mind that the American Tung planting industry is only just emerging from its pioneer stages, under which there have been, naturally, some failures, due mostly to ignorance and lack of judgment in planting on unsuitable land. Nevertheless, I want to say that we owe these early planters a debt of gratitude, for having pioneered and shown the way, and in particular, what not to do.

With present knowledge, successes can and are now being duplicated, and it is no longer necessary to harp on failures, or even to quote averages, where these averages are based on partial failures, the causes for which are now known. And it is just as unfair to quote depression prices of the product without at the same time stating the ten-year average, since it takes six to ten years to bring a Tung grove into good bearing.

Now to return to my initial interest: I had heard of Florida Tung trees, for several years, but did not become seriously interested until three years ago when Mrs. Bennett and I made a trip around the world. In China we saw something of the Tung industry — sufficient to form some opinions and as a basis for comparison with the industry here. On our return I came to Florida and investigated through the Gainesville Chamber of Commerce and The Florida Experiment Station. I studied the local groves and then proceeded to cover the Gulf Coast as far as Louisiana. I finally came to the conclusion that a Tung grove in this most favorable climatic zone

offered exceptional opportunity for a safe and profitable investment.

I reached this conclusion for several reasons which I will now cite; and for practically the same reasons that the wild rubber and low cost labor of the Amazon can no longer compete with these same wild South America rubber trees, transplanted and grown in orchard form in the far East. With some varying conditions, the same applies to pecans, coffee, coconuts, and many other now cultivated products, once wild.

And, in my opinion, the great bulk of the Chinese Tung trees can properly be called "wild trees." For simplicity I would classify these Chinese trees, as "good," "average" and "poor," with the latter predominating. The large majority of all are on barren lands and on rough hillsides, impractical to cultivate or fertilize, and commercial fertilizers are not generally used in China. Under these conditions of neglect, Chinese Tung trees average the short life of twelve to fifteen years. On correct soils in Florida, properly spaced and cared for, Tung trees should have a productive life of fifty years. The eighteen-year-old trees at The Florida Experiment Station, while not under ideal conditions, nevertheless show continued healthy growth, with increase in production, yearly. The twenty-five-year-old tree at Cairo, Ga., while occasionally damaged by frost, is a healthy specimen, with a present spread of forty-five feet, and is increasing in growth, annually.

A comparison even more favorable to Florida may be made with respect to production. The so-called "good" trees in China are said to bear an average crop of around 200 fruit. Last fall, a committee from our Gainesville Chamber of Commerce inspected several six-year-old commercial groves and counted over 2000 fruit on many trees in all of these groves. Such production is equal to twenty-five pounds of oil per tree. The eighteen-year-old No. 9 test tree at the Experiment Station, reported a 1931 crop of 164 pounds of dried shelled nuts (6000 fruit) equal to fifty-five pounds of oil. Many similar examples could be quoted.

But I am not in sympathy with representations of productions based on exceptional yields from individual trees. Fortunately for the first time in the history of the American Tung oil industry, we now have reliable production reports from several commercial groves of six years of age. Of all of these the "Williamson," six-year-old grove probably made the world's production record, for the 1931 crop, of 6000 pounds of dried fruit per acre, equal to 1200 pounds of oil.

We have gone carefully into the question of cost and it is the concensus of opinion that under mass production methods, a superior quality of American plantation-grown Tung oil can be produced at a cost of not to exceed five cents per pound.

In China I was able to determine, to my own satisfaction at least, that we never need fear Chinese Tung oil competition. In the first place China is said to consume forty per cent of her Tung oil production and as all good lands must be devoted to crops to feed her hordes, generally on the verge of starvation, it is believed that she cannot largely increase her production. With peace and China's awakening, her local consumption is certain to increase, leaving less for export. Second: their curing, milling and pressing methods are such as to produce a discolored, dirty, inferior and generally adulterated oil that must be refined and bleached before sale here.

Considering their crude methods and many burdensome handicaps, I believe that Chinese labor, calculated at even five cents per day, gold, would be classed as expensive. And the Chinese will not change these centuries-old customs. For this very reason they lost their immense tea business to Ceylon and India. And for this same reason I believe that we stand a good chance to fall heir to the bulk of the world's production of Tung oil.

Our domestic Tung oil industry is expanding rapidly, and new uses are constantly being found. The development of by-products, through chemical research, promises to add untold values and profits to growers. And I never heard of an industry where the human element entered to so small a degree. This means that the loss through cheap labor inefficiency is reduced to a minimum.

Another great advantage is the fact that American plantation-grown Tung oil has a waiting market, at a premium above the inferior Chinese product, at no selling cost. In practically every line of production, selling costs run high. In my former manufacturing business, the cost of selling our product exceeded twenty-five per cent of the total of all costs. I could go on enumerating many other irrefutable points in favor of the American Tung oil industry.

What the industry now needs for more rapid expansion, is official government recognition and co-operation, along constructive lines. Fortunately the chief of this department of the government is alive to the situation and plans are on foot to accomplish this very thing. For some time it has been the policy of the United States government to encourage the home development of products which are a necessity to great American industries. The government appropriated $500,000 to study and encourage the potash industry, with the result that it is now free from foreign domination.

Government officials realize that Tung oil *is* a vital necessity to great American industries now at the mercy of chaotic conditions in Asia. And they also realize that approximately $100,000,000 is being sent out of the country annually that should go into the pockets of American growers. They believe that this business is worth going after.

Because of our adapted climate, soil and rainfall, it is believed that there are no competing world's areas of production, except China. If this is so, it means that America will eventually supply the bulk of the world's consumption of Tung oil.

I feel so encouraged over the whole outlook that I am planning a program of expansion, that I hope will induce others to follow.

I thank you.

Mr. R. C. Simpson: What would be the reasonable profit per acre for a grove ten years old?

Mr. Bennett: That matter has been gone into by the Chamber of Commerce, and they have a pamphlet on that, or rather will have. I suggest you call at the Chamber of Commerce.

Mr. L. B. Skinner: What's the method of gathering the nuts?

Mr. Bennett: The early frosts knock the nuts and leaves off the tree, and the earlier those frosts come and the longer the tree stays dormant, the more vigorous the tree comes out in the spring and puts on its fruit. It is for that reason that there is a climatic zone. That zone has not been fully established. Probably it will take in Polk County and as far north as the southern portions of Louisiana, Mississippi and possibly Georgia. I assume probably not over five per cent of the lands within that zone are suitable for Tung oil. The tree positively will not stand wet feet. Any child knows that you would not plant an oak tree in a cypress swamp, and that's what they are doing when they put Tung trees on wet lands, unless they are thoroughly drained. I believe flat woods lands, if they can be drained, may be found suitable, but they would have to be drained fifteen or twenty feet, in my opinion.

Member: Have you any encouragement for planting on light ridge lands?

Mr. Bennett: I think very little, not further south than Polk County. I saw a nursery at Avon Park, a 50,000-tree nursery, two years ago, that did not drop all of its leaves. If the tree does not drop its leaves and go dormant, it will not properly fruit. There are trees at Palm Beach and Miami—beautiful specimens, but they fruit very little. The dormant period seems to be very necessary, as with pecans.

Member:: Doesn't the tree require a considerable amount of moisture?

Mr. Bennett: It is very drought-resistant. It will send the tap root a long distance. We dug up some trees near Sumterville, owned by a Spaniard in that section. He had two and three-year-old trees with tap roots that ran twelve feet, some even further, looking for moisture. There was no clay there, just pure white sand. They were beautiful specimens.

Member: My difficulty has been in getting them to go up.

Mr. Bennett: There may be some soil condition that is not friendly to the tree. Where is your place?

Member: Pasco County.

Mr. Bennett: One of the largest trees in Florida is at Lutz. I discovered some two weeks ago, some eighteen-year-old trees, east of Brooksville — on the road from Brooksville to Dade City — which had been subject to all sorts of neglect. When we arrived there was a fire under the largest tree; it had been apparently burned very many times. That tree was quite stunted, not as large as our five and six-year-old trees here.

Mr. Simpson: Do they grow better with a clay sub-soil or do they prefer sand?

Mr. Bennett: On light, sandy soils, I should say yes, such as you have in Polk County for citrus. I believe the citrus type is admirably suited for Tung trees, if in the correct climatic zone. It needs the frost and yet it will not stand probably more than six or eight within the dormant period. The greater danger is during the bloom period. Frost on the bloom would injure the crop, that high. That's what happened in Georgia and Mississippi, Louisiana and Alabama. There is one grove, planted at Picayune, Miss. (Not grove, reforestation) where Mr. Rowland has taken his cut-over lands, which had ten or twelve thousand of feet of timber to the acre, and through those stumps he has plowed a furrow through the stumps, and then another furrow, and in those furrows he has planted Tung trees every fifteen or twenty feet. He doesn't expect to cultivate or fertilize; it's just simply a case of the survival of the fittest. It's a very noble experiment; whether it will succeed remains to be seen.

Mr. Burton: Do they grow on lime soil?

Mr. Bennett: Lime and phosphate seem to create alkalinity, which seems to be poison to them. I think lime and phosphate lands should be avoided. It requires an acid soil condition.

EXPERIENCES IN TUNG TREE CULTURE

Geo. P. Hoffman, Penney Farms, Clay County

Experiences during nine years of association with the culture of Tung trees, experimentally and commercially, are, to me, more interesting to relate than to retrace or repeat. However, be my experiences and the experiences of others what they may, our combined experiences have made for progress and a better understanding of the needs in further developing and stabilizing this infant industry.

Not unlike many of our outstanding crops serving as the backbone of industry, well illustrated by the development and growth of the Egyptian cotton industry in the southwest, the development of American Tung oil culture to the point of serving as an industry, might necessarily be expected to undergo many changes. A very careful and well recognized investigator recently stated that most new crops suffered before succeeding an average of three conspicuous failures with the resulting expenditures on part of the United States Department of Agriculture and its co-operating agencies, of a sum approximating $40,000. The development in America of the Egyptian cotton industry was used as an illustration and attention was called to the fact that not a single variety of the several varieties brought over was originally found suitable and capable to meet the conditions of this country. Nevertheless, these varieties served as a basis or foundation from which American developed varieties stabilized the Egyptian cotton industry in the United States.

It is to be hoped that our American Tung oil industry might develop to an economically satisfactory point without suffering reactions paralleling those above mentioned. We, who have had experience even in a very limited way, appreciate the grave necessity for further scientific

work with the resulting findings which will give us maximum production at minimum cost; also, profitable market outlet for both the oil and the by-product. Experimental findings in any crop and most especially a perennial crop well illustrated by Tung oil, can only be expected to develop just so fast. It is unquestionably true that time and money, in case of some of our most valuable crops, have been lost by permitting commercial plantings of great extent to develop beyond the application of experimental findings. It is not intended that this statement be misconstrued to mean that my associates and I personally do not have the greatest faith in the future of our American Tung oil industry but rather in our own humble opinion to sound a warning against exploitation or "fly-by-night" plantings, as it is our desire for the industry to become soundly stabililzed.

We are much encouraged in the progress that we have already made and the future industry of Tung oil growing as an industry. Evidence of our faith in the future of this infant industry is well illustrated in our having more than 1,000 acres (approximating 100,000 trees). Obviously, we appreciate and support the fact that experimentation and fact-finding should precede the development of this industry and serve as a beacon for commercial plantings that might follow. Consequently, our first planting was a sixty-acre co-operative experimental grove for a study of soil types, made in December, 1925. In January, 1929, and February, 1930, one thousand acres — five hundred acres each year, were planted.

Our groves have shown satisfactory response to good attention — careful cultivation, fertilizing and cover-cropping. A combination of clean cultivation, companion cropping and cover cropping has given both satisfactory and economical results. Crotalaria is unquestionably the best and most economical cover crop used up to this time.

Through lack of authentic information, reliable information gathered from a sufficiently large area to reduce the error to the minimum, enthusiasm and exploitation (in some instances), yields might be greatly over-estimated and misleading.

Yields from one of our grovves planted on Norfolk sand and which has not received the best of attention, show the following: (The yields are given in pounds of air dried-fruit and oil for the years of 1929, 1930 and 1931):

SPRING BANK GROVE

Planted—January, 1926.
Acreage—20 acres.
Trees per grove—2,000.
Trees per acre—100 (average).

Year	Per Tree		Per Acre		Total Yields	
	Fruit	Oil	Fruit	Oil	Fruit	Oil
1929	1.87	.374	187¼	37.4	3.745	749
1930	2.61	.522	261¼	52.2	5,225	1045
1931	4.87	.974	486¾	97.4	9,737	1947
Av. 3 yrs.	3.12	.623	312	62.3	6,236	1247

It is interesting to note that the yield is gradually increasing as the trees grow older.

Growers and prospective growers should carefully and cautiously observe the best practice or practices in the community or communities in which they are planting or contemplating growing Tung oil. More stress than the subjects justly deserve cannot be given the following points:

Soil selection,
Preparation of soil,
Time of planting,
Depth of planting,
Methods of fertilizing,
Cultural practices — avoid root breakage or cutting.

There is a great diversity of opinion as to the best soil type and it is doubtless true that Tung oil is not extremely exacting as to its soil type if the soil be well drained. We have found that trees grow and thrive in a very satisfactory manner on the better grade of Norfolk sandy loam soil. Preparatory to planting, it is our practice to harrow, followed by turning and a second harrowing, thereby making a well prepared seed bed. January and February planting seem to have given us best results. The Tung oil tree is

very sensitive to deep planting and it would seem that the trees should never be planted deeper than they stood in the nursery row. Applying fertilizer of any kind at the time of planting seems to have given no better results than if the fertilizer be applied at a later date or put on about the time the trees break bud. Thus far, we have found organic carriers to give excellent and satisfactory results. It is desirable that two applications be made — first about the first of March and the second about the first of June. A cultural program which will result in the tree making a satisfactory growth and keep the ultimate cost to the lowest possible minimum, will doubtless be satisfactory. A combination of clean cultivation alongside the tree row, crotalaria in the tree row, and in instances companion crops between the tree rows, have given very satisfactory results.

Economical success and stabilization in case of any new crop as Tung oil is demanding of such careful experimentation in the development of high yielding strains, correct cultural practice and means of economically and profitably utilizing the final product. Authentic and reliable research, which should guide the growth and development of our Tung oil industry, necessarily requires the expenditure of both time and money on part of our experiment station workers. Growers should lend their support in this respect.

Commercial grove management and experimentation represent two entirely different and widely separated angles or phases in production and usually involve men having widely different training, experience and viewpoints. Consequently, growers and prospective growers should, for their own financial protection and the protection and development of this infant industry, acquaint themselves with the authentic and published work and avail themselves of the freely given advice and help of the Florida Agricultural Experiment Station and its co-operating agencies. Needless mistakes and resulting loss and faith-breaking with this promising and infant industry might rightly be expected where "hit and miss" methods and practices are used.

Mr. Hoffman: I have been surprised during my six years' work with Tung oil at Penney Farms to find people will come to our organization, and while we are glad to throw open our records to them and give them information such as we have, yet they will stop and ask for information rather than go and avail themselves of the published information of our Experiment Station. My practice, in a restricted district, such as we are working on (and such would apply equally well to the work of other growers) might not suit the local conditions under which the prospective planter of Tung oil would locate. Thus my advice in this paper. I think we have kept the cost of our groves down to a minimum. I think at times we have not fertilized as freely as we should. We have been to some extent disappointed in our yields, but this is in no sense intended to convey the idea that we have any faith breaking in Tung oil. We are trying through the co-operation that we are getting (and we certainly enjoy the best of co-operation) to find the best trees in the thousand acres that we have. From these trees we hope to propagate. I think the low percentage of fruit set that we have in comparison with the bloom we find on the tree is a danger signal. I will clarify my statement by saying that we need (using the slang expression) to be on our toes to find the high yield tree, and get away from this thing of propagating from seed. I know there is some difference of opinion there, but if we had our troubles in the early making of the pecan industry, why should we retrace the same ground by propagating from seed? A very careful investigator whose ability is recognized has said it is really a reflection on the horticulturist of today to be satisfied with the planting or development of great areas of Tung oil by the use of seed. We had to have a beginning; we have had our beginning from the seed, but let's not be satisfied to remain at that point.

I shall be glad to answer any questions that I might feel that my experience will make possible for me to answer. I want to say at this point that if any time any of our friends here would like to visit our groves at Penney Farms, just a short distance from here, we would be

TUNG OIL GROVE NO 14—J. C. PENNEY-GWINN CORPORATION, PENNEY FARMS (CLAY COUNTY, FLORIDA)

Location—Satsuma Heights, north of Highway 48—350 Acres.

Planted—Spring, 1929

	Cost of Establishing Grove	1929 Cultivation Cost	1930 Cultivation Cost	1931 Cultivation Cost	Total Grove Cost to Jan. 1, 1932	Per Acre Establishing Cost	Per Acre Cultivating Cost 1929	Per Acre Cultivating Cost 1930	Per Acre Cultivating Cost 1931	Total Cost Per Acre to Jan. 1, 1932
Clearing Land	$ 2,537.50	$	$	$	$ 2.537.50	$ 7.25	$	$	$	$ 7.25
Fencing	1,095.50				1,095.50	3.13				3.13
Preparing Land	3,500.00				3,500.00	10.00				10.00
Trees—96 to acre	8,400.00				8,400.00	24.00				24.00
Planting Cost	672.00				672.00	1.92				1.92
Fertilizer	931.00	1,277.50	2,724.00	1,137.00	6,069.50	2.66	3.65	7.78	3.25	17.34
Plowing, Harrowing and Hand Cultivating		2,089.50	1,750.00	1,444.01	5,283.51		5.97	5.00	4.13	15.10
Cover Crop Seed		350.00	148.35		498.35		1.00	.42		1.42
Planting Cover Crop		350.00	148.35		498.35		1.00	.42		1.42
Replacement Trees and Planting Cost			325.50	14.88	340.38			.93	.04	.97
TOTALS	$17,136.00	$4,067.00	$5.096.20	$2,595.89	$28,895.09	$48.96	$11.62	$14.55	$ 7.42	$82.55

Total cost first two years of grove not planted to corn and grazing crop ---------- $75.13

Total cost first two years of grove planted to corn and grazing crop‡ ---------- 59.91

Reduction in cost by planting corn in grove ---------- 15.22

TUNG OIL GROVE NO. 23

Location—South of highway—East of Kingsley Lake—135 acres.

Planted—Spring, Year 1930

	Cost of Establishing Grove	1930 Cultivation Cost	1931 Cultivation Cost	Per Acre Establishing Cost	Per Acre Cultivating Cost, 1930	Per Acre Cultivating Cost, 1931	Total Cost Per Acre to Jan. 1, 1932
Clearing land	$1,350.00	$	$	$10.00	$	$	$10.00
Fencing	422.55			3.13			3.13
Preparing Land	877.50			6.50			6.50
Trees—96 to Acre	3,240.00			24.00			24.00
Planting Cost	259.20			1.92			1.92
Fertilizer	359.10			2.66			2.66
Plowing, Harrowing and Hand Cultivating		806.04	273.70		5.97	2.03	8.00
Fertilizer		492.75	310.92		3.65	2.30	5.95
Cover Crop Seed		135.00			1.00		1.00
Planting Cover Crop		135.00			1.00		1.00
Replacement—Trees and Planting Cost			292.88			2.17	2.17
	$6,508.35	1,568.79	877.50	48.21	11.62	6.50	66.33
CORN CROP PLANTED 1931							
Cost of growing and harvesting* 90 acres of corn			1,800.00			13.33	13.33
Yield—cover crop—average 35½ bushels per acre at 75c per bushel			2,396.25			17.75	17.75
	$6,508.35	1,568.79	281.25	†48.21	11.62	2.08	‡61.91
					Less grazing value‡		2.00
							.08

*Rows spaced 30 feet apart; 6 rows between each two rows of trees—two-thirds distance occupied by corn.

†Average return per acre of the corn crop based on 135 acres.

‡Taking into consideration the grazing value of the corn and velvet beans at the minimum value of $3.00 per acre would reduce the total cost per acre from $61.91 to $57.91. 90 acres at $3.00 equals $270.00, divided by 135 acres equals $2.00.

2.00

59.91

very happy to have you, and at that time we would be very glad to show you some of the work of the Experiment Station, and fertilizer findings, which plot work is now going into its second year.

L. B. Skinner: Hasn't there been some work done in getting budded trees?

Mr. Hoffman: In a limited way, yes sir.

Mr. Skinner: I understood there was quite a little. I am interested in a Tung grove.

Mr. C. H. Simpson: I would like to ask a question. Mr. Hoffman, you said your sixty-acre grove, six-year old trees produced 486 pounds of nuts per acre.

Mr. Hoffman: Yes.

Mr. Simpson: And Mr. Bennett mentioned that a six-year old grove of Mr. Williamson's produced 6000 pounds, if I get that straight.

Mr. Bennet: Air dried fruit. Two acres.

Mr. Simpson: Was it a large acreage or select acreage?

Mr. Bennett: It was two acres.

Dr. Blackmon: Is yours shelled seed?

Mr. Bennett: Yes, air dried nuts or fruits. "Nuts" would be a misnomer. Our yield was accurately weighed, air-dried fruits, and bear in in mind that I preface that statement by saying the groves were originally planted to soil type study, and these groves were not in as good condition as they should be.

Mr. Skinner: May I ask where you selected some trees to bud from, and what has been the production of those trees?

Mr. Hoffman: I can't answer that. I refer you to Prof. Mowry. He probably has done more of that work than anyone else, to my knowledge.

VARIETIES AND PRACTICES IN THE TUNG-OIL GROVE

Harold Mowry, Gainesville

Florida's Tung-oil acreage now probably exceeds 10,000 acres and, if present plantings show anything like anticipated results in approaching maturity, the acreage no doubt will be materially increased in the near future.

All of the commercial acreage in the State consists entirely of seedling stock, as has been the history of most first ventures in the growing of fruit and nut trees. A large part of the trees now growing are from seeds obtained from any available source, little or no thought having been given to the desirability or productiveness of the parent trees. The condition was not due specifically to a lack of diligence but to the scarcity of information available as to the degree of variation that might exist. It has been but recently that comparisons of mature trees could be made because so few of them were available for study. No information has been obtainable from China that would show the extent of variations or whether it would be worth while to select for planting only seeds from parent trees of merit or to resort to the practice of asexual propagation.

The questions have arisen as to whether large variations occur in the yield of different trees, whether the oil content is the same in all fruits, whether the proportion of seed or oil is alike in large and small fruits, and whether fruit size and thickness of hull affect the size of the seeds and the proportion of oil contained in them. In an effort to find an answer to these questions, studies have been made to determine and evaluate the extent of differences occurring in Tung-oil trees and fruit that the most desirable types of trees might be accurately selected; to determine whether certain variations noted in different trees were inherent or due to environmental influences; and to ascertain whether desired characters might be perpetuated through seeds or by vegetative methods of propagation.

Twenty-three trees were chosen for study, ten of them being eighteen years old and the others in their seventh, eighth, and ninth years from the time of planting. Comparative analyses of

fruits from nine seven-year-old trees growing at the Florida State Farm at Raiford were also made. All analyses were of the 1931 crop.

The differences considered and on which studies were made include yield, fruit size and weight, number of seeds per fruit, number of seeds per pound, and percentages of kernel, oil, and testa (seed coat) in the seed. For each tree of station plantings 200 fruits taken from all parts of the tree were used for analysis. Measurements were made on matured, but not dried or shrunken fruits, and the weights were on air-dry materials other than the oil content of kernels which were calculated on an oven-dry basis.

Fruit sizes and weights. Tung-oil fruits vary considerably in shape and size. Some have a quite smooth external surface, while others may be irregularly roughened or ridged. The variation on an individual tree usually is slight but an occasional seedling bears fruits of widely differing shapes.

In most instances the fruits were of greater breadth than length but the opposite was true in the fruits of a few trees. In the mean transverse diameter the extreme variation in the different trees was from 3.48 cm. to 6.65 cm. and the mean longitudinal diameter from 3.76 cm. to 5.96 cm. The Craig variety had a transverse diameter of 8.03 cm. and a mean longitudinal diameter of 6.07 cm. (2.54 centimeters equals one inch).

Fruit Weights. The average weight of single, air-dried fruits varied from .44 ounces to 1.44 ounces in the several trees. Like fruits of the Craig variety had an average weight of 2.08 ounces.

The thickness of hulls of undried fruit from different trees also varied considerably but on drying the difference was materially lessened. In most instances the percentage weight of hull in the fruit increases in direct ratio to its thickness and the percentage weight of seed is proportionately lowered.

A direct correlation exists between size of well-filled seeds and the number of seeds per pound; the number in inverse ratio to the size. The extreme variation in number of air-dried seeds per pound was from 85 to 227.

Ratio of seed and hull in whole fruits. In the Station plantings the highest percentage of seed found in the whole, air-dried fruits was 66.4 per cent and the lowest 50.2 per cent, an extreme difference of 16.2 per cent.

With other factors equal, the fruit having the greatest proportion of seed to hull, by weight, would be the most desirable. No apparent advantage was found in the trees producing either very large or thick-hulled fruit.

Proportion of kernel and testa in seed. The percentage of kernel in the seed varied from 54.5 to 66.0 per cent, or 34.0 to 45.5 per cent testa (seed coat), an extreme difference of 11.5 per cent. Usually the larger the seed the greater the percentage of weight of kernel contained. No apparent correlation exists between kernel weight and percentage weight of seed or of hull in the fruit.

Oil content. Of the different Station trees analyzed the seed kernels were found to vary in oil content from 53.97 per cent to 66.31 (tree K2) per cent (oven-dry basis), a maximum difference of 12.34 per cent. Generally, it would appear that with most thrifty well-nourished trees the oil content of the kernels will fall within a range of 58.0 to 61.0 per cent.

The oil content of the air-dried seeds and fruits shows a much wider difference than in the kernels due to the factors of hull thickness, seed size, and testa thickness. In the air-dried seed the range was from 28.07 to 37.31 per cent and in the dried, whole fruits from 17.63 to 24.53 (tree K2) per cent.

An interesting and significant contrast in oil content was found between the fruits of the Station plantings and those of some trees at the Raiford State Farm. The trees of the Raiford planting in their seventh year were of the same mixed parentage as Station plantings, having been supplied from Station stock. They had been given but little in the way of cultural attention, including only about two pounds of fertilizer per tree during the whole seven-year period. The size and external appearance of the fruits dif-

fered little or none from those of other mixed seedling plantings but the oil content was considerably lower than a normal average. A ton of dried mixed fruits of the Station planting would have contained over 100 pounds more oil than a like amount of mixed fruits of the Raiford planting. Differences of such magnitude are worthy of consideration in determining cultural practices to be followed for greatest return in the way of oil production.

Yield. Profitable production of Tung oil is dependent on heavy yields. Soil moisture, soil type, and cultural practices may exert a strong influence on the size of the crop but the tree's fruiting habits also must be included among the major contributing factors affecting yield.

That seedling trees vary widely in fruitfulness is strongly demonstrated by tree yield records extending over a period of years. An inherently heavy-fruiting type of tree is required to secure maximum yields, since, irrespective of soil fertility and suitability of cultural practices, a tree of low-yielding capacity will continue as such year after year.

The yields of the ten eighteen-year-old trees show that some reguarly produce heavy crops and others as regularly produce little. It is of interest to note that over a four-year period two of the trees bore as much as the combined yields of the other eight.

Tree production records of all Station plantings show the trend of seedling trees toward consistently variable yields to be similar to the above ten trees. Even though it is quite probable that the same situation holds true in most commercial plantings the condition should not be construed as meaning that those plantings will not bear profitably on reaching maturity. Rather, the situation appears to be that production in future plantings may be materially increased by a careful and intelligent selection of seed for planting or by budding seedling nursery stock with buds from mature trees of proved merit. There is no longer a dearth of seed for planting purposes so that the further planting of seed from any and all sources, with the consequent high degree of seedling variation, is not necessary. There is little doubt that the acre yield can be increased over that of miscellaneous seedlings by the relatively simple expedients of seed selection or use of budded stock.

It must be borne in mind, of course, that suitable cultural practices and soils must be taken into consideration. Irrespective of the fruitfulness and desirability of a given variety, it cannot be expected to yield more than in mediocre quantity, unless conditions are such that a high degree of thrift in the trees is maintained. Enough cultivation of the trees in their first three or four years to keep down encroaching grass and weed growth may be considered as a requirement. If the lands on which the trees are planted have been thoroughly broken, present indications are that the amounts of cultivation given may be materially decreased as the trees attain greater age and size. The practice of planting on but partially cleared lands, wherein the trees are planted in narrow strips of cultivated soil and the areas between left unstumped and unbroken, has yet to prove its merits. On Station plantings the use of complete fertilizers in moderate quantity has materially increased both tree size and yield over unfertilized check plots.

Seedling and budded tree behavior. Tests have definitely shown that the characteristics of the tree from which the scions were taken were transmitted to the budded trees. This was strikingly demonstrated by inserting a bud of a prolific tree, bearing typical fruits in clusters, in a branch of a low-yielding mature tree that bore singly only irregularly shaped fruits. The bud resulted in a single upright branch bearing fruits in clusters typical of the tree from which the buds were taken. Oil analyses of the air-dried fruits showed those of the budded branch to contain 8.3 per cent more oil than the fruits of the other branches of the original seedling stock tree.

Seedling trees and budded trees, of the same parentage, produced fruits nearly identical in all characteristics, including weight, size, shape, and internal composition. The seedling trees made the larger growth but varied greatly in yield, while the smaller budded trees yielded in almost identical amount and in total exceeded the production of the seedlings.

Varieties. Varietal names given to Tung-oil trees in China evidently are without significance and are not there generally used.

The differences appearing in Florida plantings that have led to a meaning of varieties have been: the large sized and often misshapen fruits of the Craig; the willowy growth and peculiarly distorted foliage of the Moore; and the production of fruits in clusters of the so-called Cluster type.

The Craig variety derived its name from that of a Florida grower in whose planting it was first noted. Its chief distinction lies in the large size of its fruits, many of which as a result of fasciation of the twigs are very large and distorted or huge flatly oval specimens. There may be as many as twenty-two seeds in one of the single fruits but the usual number is seven or eight. The yield of this variety has not been above average and it at present shows no superiority over ordinary seedlings.

The Moore variety was first noted by Rolfe Buckley on the properties of the Alachua Tung Oil Corporation at Gainesville. Its foliage is distinctively distorted and the fruits are small but have an exceptionally thin hull. The tree is very prolific but lacks vigor. Unless a more vigorous growing strain is developed it apparently cannot be considered of much commercial worth.

In the Cluster type, at the time of blossoming, the cyme has not only the apical pistillate flower but, generally, also one or more pistillate blossoms borne laterally. This type of flowering leads to the production of several fruits at the twig terminal — commonly referred to as "cluster" fruiting.

Both Station and commercial plantings have demonstrated the fruitfulnes of trees of the cluster-bearing habit, tree records showing them to have produced the greater average yield. As an instance of the heavier bearing of Cluster trees, in a block of ninety nine-year-old Station trees, in which forty-nine bore their fruit in clusters and forty-one singly, the average of the 1931 yield of the clusters was slightly over twenty-seven pounds of air-dried hulled seed, while that of the singles was but slightly over eighteen and one-half pounds.

No measurable differences are apparent between the foliage and individual flowers of the Cluster trees and those of miscellaneous seedlings. The type is principally characterized by its cluster-fruiting habit and prolific yields. Most seedling trees of the type apparently bear fruits that are quite similar in all respects but there is a variation in productiveness. Even with a variation in yield within the type, it produces, as has been shown, heavier average yields than trees bearing their fruit singly. With a single exception, no recorded tree yield of single fruiting trees has exceeded that of Cluster trees. That exception is one of the older Station trees and its seedlings, as well as scions, are now undergoing comparative tests with Cluster trees in larger field plantings.

There is no reason to suspect that the so-called Cluster type is a pure-line strain and that all seedlings from such trees will be identical in characteristics. Some variation is to be expected in seedling trees, irrespective of the source of the seeds. Variation due to genetic composition may be eliminated by asexual methods of propagation of which budding appears to be the most feasible.

Summarizing, it may be said of the several variations found that yield is of first importance. Heavy yield is of far greater value than the presence of minor desirable characteristics in less prolific trees since in most instances only a few extra pounds of fruit are required to offset gains accruing from the minor differences in fruit composition. Yield alone, however, should not be the sole basis of future selection. All additional properties that will make for a greater percentage of oil in the fruit are of value and when combined with high yields will eventually assure highest oil returns.

FLORIDA EXPERIMENT STATION.

Member: What method of budding do you use?

Mr. Mowry: Post Budding. See Bulletin 221 of the Experiment Station.

THE TANGERINE INDUSTRY

Howard Phillips, Orlando

You have listened to addresses on one of Florida's latest industries, and I am now going to appeal to you to help save one of Florida's oldest industries — the Tangerine industry.

Some of you from the northern part of the State do not realize what is taking place in the southern part of the State, where we are growing Tangerines now. There are hundreds of acres of Tangerines coming into full bearing, and hundreds of acres which will come into full bearing in the next few years, and as these plantings are coming forward every day greeted by a market which returns nothing to the grower, this has caused us considerable concern, especially my father, because he unfortunately happens to be the largest individual Tangerine grower in the world; in one grove alone he has over 1000 acres of Tangerines, and has altogether considerably over 2000 acres.

At one time Tangerines were the most profitable citrus crop grown. We would get $3.00, $4.00 or $4.50 a box on the trees. Now we are fortunate if we can ship them without getting red ink. This is the situation which we are now facing — some of them by cutting down their trees. I know of one grower at Lake Alfred who has cut down over seventy acres of Tangerine trees. I know of one grower at Lakeland where forty acres have been cut down. I know of hundreds of acres of smaller plantings which have ben cut down, and to what avail? It doesn't help the man who has Tangerines; it surely doesn't help the State, and it's altogether a most disastrous affair, especially since such an occurrence does not have to exist.

The situation was so alarming to us that we decided to investigate the reason for the declining prices of Tangerines, and this is what we found: That it was not because there were too many Tangerines in the State; it was because they were marketed wrong. In a survey which we made of the 1931 crop, and in which we had available the figures of the Florida Citrus Exchange, the Clearing House, and all of the independent shippers, we found that eleven markets in the United States were taking seventy per cent of the Tangerines, and that in 259 markets to which Tangerines were shipped the other thirty per cent was scattered over practically 100, which left about seventeen per cent of the people without any Tangerines, and about thirty-five per cent of the people eating seventy per cent of the Tangerines. We found New York City alone took twenty-seven per cent of the Tangerines shipped out of the State, and all in all it was a most disagreeable, most distasteful and most useless sort of a marketing arrangement.

My father has advocated for the last year a plan which he has presented to the Clearing House, and to the Citrus Exchange, to remedy this matter. It is simple. It is not new in substance, and it is extremely practical. He hopes that the two existing organizations, the Citrus Exchange and the Clearing House, will get together, and will call in the independent shippers to form a committee for marketing this fruit through effective advertising. That is, not National advertising, but advertising in those markets which are not now using Tangerines, through a rigid control of shipments both as to quality and as to quantity, and an attempt to introduce them into markets where they are not now known. This work we have done to a certain extent on cur own. We have taken markets that have not heretofore known Tangerines, and have been able to show wonderful results, in three markets in particular — Terra Haute, Ind., Little Rock, Arkansas, and Oklahoma City, Okla., places that have never before used Tangerines. Under the stimulus of limited advertising, under the stimulus of predisposition of Tangerines, and under the stimulus of hard work, they have been made to consume more than their pro-rata share of Tangerines. These three places indicate to us that with over 200 markets of similar size unex-

ploited we do not have to ship our Tangerines and get red ink, if we are willing to get together.

Dr. Phillips, my father, has been over the State in the last month, telling the growers of his plan, enlisting their aid, and hoping that he will be able to put this across, through their aid and through their efforts, because it is not a one-man proposition; it can't be done by one man, or one organization. Shippers generally are uninterested, because they have not enough Tangerines to make it worth their while to take the trouble. Others are frankly hostile, because they say they do not wish their business interfered with. Fortunately, the two largest organizations, the Exchange and the Clearing House, have shown willingness to listen to the plan.

It behooves, I think, this Society and these members to investigate this plan thoroughly, to see if it has merit, and if it has merit to advocate it, because there is no reason why, with Florida's monopoly (because it is the only monopoly we have in the citrus field) that we cannot get a good price for our Tangerines. But if you are willing to stand back and see Florida lose its Tangerine trees, lose from one-half to a million and a half dollars a year in shipping Tangerines and getting red ink, then forget that I have been before you, but if you are unwilling to do this, investigate the plan and see in what way you can help.

I thank you.

THE EFFECT OF VARIOUS WRAPPERS ON THE PRESERVATION OF ORANGES IN COLD STORAGE

W. M. Fifield, Gainesville

A study of the effect of various wrappers on the preservation of oranges in cold storage has recently been made by the Horticultural Department of the Florida Agricultural Experiment Station, the work being carried on in the Station's new experimental refrigeration plant during the past two years. The effect of various wrappers on the occurrence of pitting, general appearance, decay, taste, and loss in weight was studied.

Investigations made at other stations and with fruits other than citrus show that various wrapping materials have widely different effects on horticultural products. Several workers have found that certain oiled paper wraps were efficient in controlling apple scald, a serious apple storage trouble similar in many respects to our pitting on citrus. Government investigators in the Pacific Northwest developed a copper-sulphate-treated wrapper which effectively prevented the spread of Botrytis rot of pears in packed boxes. A Michigan investigator found a variation in the effect of different papers on lettuce, celery, tomatoes, and other perishable products. Commercial research in the frozen foods industry has indicated that different papers and other wrapping materials vary greatly in their ability to preserve moisture and quality in frozen foods held in storage.

A relatively small amount of work has been done along this line with citrus fruits. At the Porto Rico Station it was found that grapefruit and oranges wrapped in ordinary tissue developed pitting as readily as unwrapped fruit. In Australia workers found with Washington Navel and Valencia oranges that loss in weight during storage gave a very good indication of the quality of the fruit. They also observed that fruit wrapped in ordinary tissue kept in a little firmer condition than unwrapped fruit. The South African Citrus Exchange conducted an experiment with waxed bag wrappers and ordinary tissue wrappers and reported that it was doubtful whether there was any marked difference in efficiency in the two types of wrappers.

Considerable investigation has been carried on in different places concerning the effect of type of soil, fertilizer applications, seasonal rainfall

and temperature, maturity, and general condition of various kinds of fruits, as influencing the period that they could be held in storage. Other workers have found a great variation in holding quality among different varieties of the same fruit. These facts must be kept in mind in considering the effect of different wrappers on oranges in cold storage, as this particular factor is one of many which may influence the preservation of the fruit.

The procedure in the wrapper studies at the Florida Station consisted of wrapping the fruit at ordinary temperature and storing it on shelves in the various rooms of the refrigeration plant. On the shelves the fruit was placed one layer deep and arranged so that the oranges in the front row could be weighed at intervals to determine the loss in weight. All fruit on the shelves was examined periodically for decay and, at the same intervals, a certain amount of fruit was removed to an outer room held at ordinary temperatures. At the end of the first, third, and fifth day out of storage respectively, a third of the fruit was unwrapped and examined for pitting, general appearance, decay, and any effect that the various wrappers might have had on the taste of the fruit.

Three experiments were carried out. In the first experiment Pineapple oranges obtained from the Wetumpka Fruit Company at Lowell, Florida, were used. This shipment, sixteen boxes of Brights, packing 216 to the box, was wrapped and placed in storage January 13, 1931. Periodic examinations were made at the end of one month, six weeks, two, and three months. Wrappers used in this series were moisture-proof Cellophane, waxed paper, whalehide and parchment papers, and ordinary tissue. Unwrapped fruit was used as a check.

Loss in weight tests showed that the Cellophane was far superior to any of the others. Waxed paper was second in loss in weight but only a little better than the plain paper wraps. The unwrapped fruit lost very little more weight than fruit under the paper wraps.

Cellophane was also far superior in preserving general appearance of the stored fruit. In fact, after about six weeks on the shelves, most of the fruit under paper wrappers was commercially worthless, while that under Cellophane kept in a marketable condition for three months.

Pitting was worse under the paper wraps than under Cellophane but the difference was not very great. Pitting under all wrappers in this experiment greatly reduced the value of the stored fruit, except at the higher temperatures, where fruit had become so dried that pitting could not be distinguished.

At the most efficient storage temperature, 36°, 42°, and 48°, the amount of decay was too small to be of value in making comparisons. At higher temperatures considerably more decay occurred under Cellophane than under the paper wraps. This condition held true only for the first month in storage. At succeeding lengths of storage the amount of decay developed was the same or less than under the paper wraps.

For the second experiment twenty boxes of Valencia oranges, Sealdsweet grade, packing 200 to the box, were obtained from the Florida Citrus Exchange house at Clermont. The fruit was wrapped and placed in storage April 28, 1931, and in this experiment observations were made over a period of five months.

In addition to the wrappers used in the first experiment, two more were added; a thin aluminum foil, and an oiled paper, similar to that used to prevent apple scald.

The aluminum foil showed up in every way slightly better than the moisture-proof Cellophane, but the differences were not appreciable. At the end of two months' storage the fruit under aluminum showed approximately one per cent loss in weight, as compared to one and one-half per cent loss for the Cellophane, and eight to ten per cent loss in weight in paper wrapped and unwrapped fruit. The oiled wrappers were no more efficient in reducing loss in weight than ordinary tissue and, in general, fruit wrapped in the paper wraps, with the exception of the waxed paper, lost almost as much weight as the unwrapped fruit. The percentage loss in weight of Valencia oranges was very much the same as that of the Pineapples in the first experiment. The relative loss under the same wrappers used in both series was almost identical.

The chief difference noted in the two experiments was, that, while the Pineapple oranges had pitted badly after only one month in storage, the Valencias, kept for five months in Cellophane and aluminum, showed no appreciable amount of pitting at any time. Decay in the Valencia series was so negligible that no comparison could be made between the various wrappers in this regard.

In the third experiment oranges of the Pineapple variety secured from the Lake Alfred Experiment Station were used. These had been sized at the packing house but not graded or washed. Before wrapping, the fruit was cleaned with a damp cloth and allowed to dry. Only sound fruit was wrapped. Experiment 3 was placed on the storage shelves December 2, 1931, and observations extended over a period of four months. In view of the successful showing made by the Cellophane and aluminum in the preceding tests, it was decided to try out three different kinds of each in this final experiment and, in addition, two different grades of copper-sulphate wrappers were employed, as well as the oiled and tissue wrappers used before. Also, as in the preceding tests, a lot was run unwrapped as check.

The unwrapped fruits and those wrapped with oiled and tissue papers gave similar results as before.

All three aluminum foils, namely a plain, relatively heavy foil, an embossed foil of the same weight, and a plain, thinner foil were more efficient in reducing loss in weight than the Cellophanes, but the difference from Moisture-proof Cellophane was slight. The plain, heavy foil gave the best results, closely followed, in order, by the plain, thin foil and the embossed, heavy foil.

The three Cellophanes tested were M P, or moisture-proof, S S T, an intermediate grade, and P T or plain transparent. With these a much wider variation in results was obtained than with the three aluminum foils. The percentage loss in weight under the M P Cellophane was about the same as that under the embossed aluminum foil but the S S T Cellophane lost considerably more. Both of these Cellophanes were much more effective in this regard than the P T Cellophane, under which fruit lost as much weight as under the ordinary paper wraps, and in some cases even a little more.

The chemically-treated wraps showed up very little better than the other paper wraps.

A striking difference was found between the two best Cellophanes in the control of pitting. More pitting was found under Moisture-proof Cellophane than under the S.S T grade. In fact, of all the wrappers used in Experiment 3, the S S T Cellophane-wrapped fruit showed less pitting than any of the others. It was closely followed in order of efficiency by the three aluminum foils and the Moisture-proof Cellophane. The paper wrappers all rated about the same in their effect on pitting, being considerably worse in this regard than the Cellophane and aluminum wraps.

Fruit in Experiment 3, as in Experiment 2, did not develop enough decay in storage to make a satisfactory comparison among the various wrappers in this regard.

The examinations made in all three experiments concerning the effect of time after removal from storage on keeping quality were fairly consistent. It was found that with the paper wrappers, fruit gradually deteriorated in quality as the period out of storage increased. The length of time in storage had some effect on this, as well as the temperature at which the fruit had been stored. In no case, however, except where fruit had been held at low temperature for long periods of storage, did the deterioration for the five-day period become very serious. It usually appeared, when present, as a slight drying-out and as decay.

Fruit wrapped in aluminum foil, Moisture-proof, and S S T Cellophane showed no consistent deterioration after removal from storage five days with the exception of some decay as under the paper wraps.

Comparing the three series of fruit, it was found that the percentage loss in weight seldom varied over a fraction of a per cent for the same wrapper in the different experiments. Generally speaking, the Valencia oranges lost weight

at approximately the same rate as the Pineapples.

In conclusion, the results of the experiments may be summarized as follows:

1. Plain, relatively heavy aluminum foil, embossed aluminum foil of the same weight, and plain thin aluminum foil, as well as Moisture-proof and S S T Cellophane, were far superior to any of the other wrappers tested in reducing loss in weight.

2. The thin aluminum foil gave about as good results as the heavier grades.

3. Of the Cellophane wraps, M P was best in reducing loss in weight, S S T permitted more loss, but P T was no better than the paper wrapper.

4. The S S T Cellophane was better than the other wraps in controlling pitting, but was followed closely in order of effectiveness by the three aluminum foils, and Moisture-proof Cellophane.

5. Loss in weight was a good indication of general appearance of the fruit.

6. The percentage loss in weight for the same wrapper in the different experiments was consistent.

7. In one experiment Moisture-proof Cellophane caused somewhat more mold development than the paper wrappings with which it was compared. Decay in the other experiments was not great enough to afford significant comparisons.

8. Fruit of the Pineapple variety was kept in Cellophane and aluminum foil for three to four months in firm condition, while that of the Valencia variety kept for five months. Fruit of both varieties in the *paper* wraps lasted six weeks to two months.

9. Pineapple oranges showed considerable pitting at the end of one month storage but Valencia oranges stored five months showed no appreciable evidence of pitting.

10. Fruit under aluminum foil and Moisture-proof Cellophane did not deteriorate appreciably during five days removal from storage, while fruit wrapped in the various papers showed a gradual deterioration in quality as the length of time out of storage increased.

CITRUS FRUIT JUICES

Dr. A. F. Camp, Gainesville

The production of a highly marketable citrus juice has been a problem that has commanded an active interest for many years and this interest reached a peak during the three years just passed. The attempts to produce a clarified juice along the lines used in other branches of the fruit juice industry have been consistent failures. The clarified juice no longer tastes like the fresh product, the solid materials, introduced into the juice by the methods of extraction, being a necessity in the preservation of a natural taste. Other factors have also entered into the problem, such as the disappearance of certain delicate flavors during sterilization and the production of undesirable tastes by the same sources. The most active phase of the work has centered around the idea of preserving orange juice in its natural state or at least in something closely resembling its natural state. The problem of grapefruit juice has been somewhat less acute since a very satisfactory canned product has been produced and since the public is less familiar with the flavor of the fresh juice. An enormous amount of research work has been carried on, particularly with orange juice, and so far the problem has reached no ultimate solution though a number have contributed materially in the improvement of existing processes.

At the present time there is probably less active interest in the problem of preserving citrus juices than for several years past. Research work is being continued, however, so that methods will be available for those who wish to enter the commercial field either now or after a revival of interest in this problem.

The canned grapefruit juice industry is on a

fairly sound basis though the sales have fallen off somewhat from those of the last few years due to the present buying conditions. This product, while not the exact equivalent of fresh juice in taste and quality is nevertheless a very satisfactory product that has taken well with the public and improvements in the process are to be expected. Experiments on the cold storage of canned grapefruit carried on by the Experiment Station have been very successful in improving the keeping qualities of this product by aiding in the retention of the original color and texture. The same sort of experiments have not been so successful in the case of canned grapefruit juice, however, though some improvement in keeping quality has been noted.

The present status of the orange juice problem is considerably more complicated. As most of you know, two large companies froze orange juice on a large scale last season. The freezing was done mainly in small containers and intended for house to house delivery along with milk. Neither of these companies has done any freezing this year and the indications are that they will not do so. A considerable amount of the frozen product is still in storage. As far as I know, no other companies have taken up this work this year and the interest in frozen orange juice has materially declined for the time being. The reasons for this will be discussed in detail later in this paper.

Somewhat the same situation is at present the case in the canned orange juice industry. At no time have there been made such elaborate commercial efforts with canned orange juice as were made in the case of frozen orange juice. A number of the canneries that formerly canned this product are not doing so this year and the indication is that the output of this product will be very small.

Interest has recently developed in a third method of handling orange juice, namely, that of cool storing the juice for sale within a short period after extraction. This has been attempted on a small scale and with very short keeping periods by restaurants and drink stands for several years but the results have not been generally satisfactory. Recently we have been working on this problem and a number of dairy organizations are interested in the possibilities of this method at the present time. A report on some of this work will be given in this paper.

As the matter stands at present: The frozen juice industry has suffered a temporary setback; and the canned juice production has materially decreased. More research work of a fundamental nature is being done than ever before and it is hoped that we will soon see this industry actively on its feet.

In order to give a background for the understanding of some of the difficulties encountered in the preservation of citrus juices, I wish to touch briefly upon this possible role that this industry may play in connection with the citrus industry as a whole. First and foremost in the minds of many of the citrus growers is extension of the present marketing season for fruit by selling orange juice made from Florida oranges throughout the summer. It has been hoped that by this means much of the very heavy midseason production could be transferred to the summer season thus easing the midseason market, which is generally disappointing. There have been a number who have had visions of marketing practically the entire crop as juice, as a substitute for the marketing of fresh fruit, but the indications are that the market is not yet ready for this. The marketing of orange juice during the regular season will to some extent compete with fresh fruit though a highly desirable product at a reasonable price might easily extend the market beyond its present limits sufficiently to prevent severe competition between juice and good grades of fresh fruit. This extension of the market would be based on the giving of convenience to the consumer. Those interested believe that many might buy orange juice in a can or other container who would not squeeze oranges to get the same juice and, in addition, many might be reached to whom fresh oranges are not available. This is logical since convenience is always a good selling argument.

All of the above is based upon the possibility of marketing juice of first-class quality in a container that would be cheaper and more conven-

ient to use than fresh oranges. The question of convenience will be discussed more in detail in connection with the problems of the frozen juice industry.

There is the additional argument in the possibility of simplifying and cheapening the distribution of citrus fruits or their products. The juice in a box of oranges weighs less than sixty per cent of the weight of the box of fresh fruit and a considerable saving would thus be made in freight on a poundage basis though, in the case of frozen products, some of this advantage would be lost in the increased cost of icing and salting the cars. If in addition to the problem of freight a highly satisfactory product could be marketed that would not deteriorate within a reasonable time the heavy loss in decayed or spoiled fruit that commonly takes place between the grower and the consumer would be eliminated. The peel and other refuse from the juicing operation would be available at the manufacturing point in large quantities for by-products manufacture. While these products are not particularly profitable at the present time the assurance of a large and continuous supply of this material at certain points would tend to encourage work along this line and ultimately bring out additional products of value.

From the above it may seem that the possibilities along these lines are considerable and that the efforts in this direction are not useless. Dismissing the problem with the statement that the widespread production of juice would merely injure the market for first-class fresh fruit is not giving the problem the recognition or thought that it deserves.

A discussion of the difficulties involved in the production of citrus juices, and particularly orange juice, is important to the citrus grower who is not familiar with this line of work. Such a discussion will help the grower to obtain a better grasp of the field so that he may judge better as to the probable success or failure of the various ventures that are certain to be started within the next few years. In the case of pure fruit juices it is desirable to produce a product as nearly like the fresh product in taste and characteristics as possible. In the case of orange juice so many people are familiar with its taste and characteristics that the problem is greatly involved, since the standards as to what orange juice should be are established in the minds of almost all of the possible purchasers. In the event that it is found impossible to duplicate the fresh product it is still possible to market a highly desirable product that may compete with soft drinks. The difficulty here lies in the fact that it is usually impossible to label the product as fresh orange juice and, as a consequence, it comes into ruinous competition with the soft drinks unless it has unusual merit. One of the great difficulties lies in the tendency to place on the market products labelled as orange drinks that contain only very small amounts of orange juice and which are fortified by the addition of orange oil, citric acid and carbon dioxide. Such drinks frequently pass in the public mind as the equal of genuine orange drinks. A preserving process, in addition to producing a natural juice, must be cheap. Methods that increase the ultimate cost of the product to the point where it is much cheaper to buy the fresh fruit and extract the juice at home are doomed to failure as far as large scale operations are concerned. A third requirement is that the product must be convenient to handle and serve. It must be more convenient for the retailer than the handling of fresh fruit, that is to say it must not require expensive storing equipment and must not spoil easily. In the hands of the ultimate consumer it must be easy to serve, that is to say, essentially easier than the extraction of juice from fresh oranges. Products that require extensive treatment before they can be served are likely to fail. Finally, it must be possible to label the product "pure juice" without the addition of preservative of any kind. Even the notation that it contains only pure sugar in addition to the juice is likely to be harmful to some extent to the sale of the product.

Considering the canned product in the light of the above criteria it will be noted that up to the present time this product has failed in the first particular, i. e., the retention of the natural, fresh flavor. Clarified juices of the lime have been marketed successfully on a small scale in Europe and grapefruit juice which is partially

cleared by filtering has a wide sale in this country. In the case of the orange juice, however, clearing has not produced a satisfactory product and so far as I know the sterilization of orange juice in cans or bottles by either heat or other treatments has so far failed to preserve the fresh flavor. A large number of processes have been developed up to the present. None of these has been outstandingly successful, though several have been a great improvement over past methods. It is not improbable that a first-class canned product will appear in the near future. If the undesirable cooked taste can be eliminated and a desirable product put up there should be a large market available in remote districts where it is difficult to get fresh fruit and in hospitals, restaurants and similar organizations where it is sometimes difficult to keep a supply of fresh fruit on hand.

Up to the present time the frozen juice when properly handled has more resembled the fresh juice though even here considerable difficulty has been experienced. The greatest difficulty in this regard has been the development of a stale taste while in frozen storage. In our experiments here this taste has appeared even in juice frozen in glass under vacuum and is likely to be very difficult to eliminate. Juices containing much of the peel oil are also subject to the development of a terpenous flavor though this is less important than the stale taste just mentioned. Frozen juice, however, fails in some other regards at the present time. So far it has been considerably cheaper for the consumer to buy fresh oranges than to buy their equivalent in frozen juice. The extraction and actual freezing are not very expensive when properly adjusted, but the costs of maintaining the product in cold storage, shipping it frozen and handling it under proper storage at the receiving end must be added to the initial cost. So far the indications are that some reduction in these costs must be made. Additional difficulties are met in the matter of convenience. If the product is sold through a retail store proper facilities for maintaining it in a frozen condition are necessary in the store and when it has reached the consumer he must either consume it when received or have a mechanical ice box with a compartment for holding frozen products. The juice is slow to thaw even under running water and where it is needed hurriedly this delay is annoying. Several attempts have been made to design machines for quick thawing, but so far these have not been put on the market extensively. Moreover, it is likely to be difficult to sell such equipment before the buyer is assured of a continued supply of a frozen product which suits his taste and pocketbook.

These questions of convenience have been one of the large problems in the frozen foods industry and are particularly acute with frozen beverages. Fish, meat and vegetables that can be thawed as a part of the cooking process are much more convenient than beverages that must be completely thawed before consumption and which must not be over-heated in the process.

In the case of the cool stored product, extraction and bottling will be comparatively cheap. A saving on the cost of transportation will not be realized since it will be necessary to ship the fruit to the centers of consumption and extract the juice there. With the equipment now available the cost of juicing, treating, bottling and delivering should be small, no more than the cost of the same procedure for milk.

In order to give an idea as to the possibilities of the cool storing process I will briefly discuss some of the recent experimental results along this line. This work was done by Dr. A. L. Stahl, Dr. L. W. Gaddum, Mr. Harold Mowry and myself in connection with other work along this same line being carried on by the Horticultural Department of the Agricultural Experiment Station, and, while the process is still in its experimental stage, it opens an interesting line of work of great potential value.

The fruit used in these experiments consisted of fully ripe Centennial, Pineapple and Valencia oranges. Four methods of extraction were used: (1) pressing halved fruits between hemispherical forms; (2) pressing peeled and halved fruits in the same way; (3) reaming halved fruit; and (4) pressing the peeled fruits in a screw press. Since all of these methods were suc-

cessful, providing peel oil was eliminated from the juice in some way, they will not be discussed more in detail in this paper. In the case of less mature fruit, tangerines and Satsumas, the method of extraction is of more importance, the details of this work having been worked out in cooperation with a representative of the Department of Agriculture, and will be published soon.

After extraction the juice was strained through an eighteen-mesh screen, treated in various ways and either put up in jelly glasses or half-pint milk bottles. The following methods of treating the juice were studied in relation to taste:

1. No treatment, juice bottled immediately after straining.

2. Vacuumizing the juice thoroughly to remove the air and packing without vacuum.

3. Vacuumizing the juice thoroughly to remove the air and capping under vacuum.

4. Vacuumizing the juice and then saturating it with nitrogen and packaging in a stream of nitrogen.

5. Vacuumizing the juice and then saturating it with carbon dioxide and packing in a stream of carbon dioxide.

After packaging samples of the juice were stored at 32, 37, 42, 48 and 54 degrees Fahrenheit. Not all of the temperatures were used for each experiment but particular attention was paid to the three lower temperatures. All of the fruit was thoroughly precooled prior to juicing and treating. This was done as rapidly as possible so that the juice was usually placed in storage before it had risen to fifty degrees F.

Samples were examined with particular reference to taste and appearance at twenty-four-hour intervals. Bacterial counts were made in two experiments in order to determine something of the effect of cool storage on the development of microorganisms.

Juices free from oil kept excellently for seventy-two hours at the lower temperatures, i. e., thirty-two degrees and thirty-seven degrees, and in good condition for forty-eight hours or longer at forty-two degrees. In general, the lower the temperature of storage the better the keeping quality but in all cases it was good marketable juice for seventy-two hours. The taste of the stored juice was usually a little different from that of absolutely fresh juice, the most notable difference being in the development of a slight raspberry flavor in some of the samples. Beyond seventy-two hours the juice developed a slight stale taste which gradually increased and was not greatly different from the stale taste that developed in frozen juice. Vacuumizing improved the characteristics of the juice somewhat and helped it to maintain its flavor even though the juice was subjected to air contact while being placed in the milk bottles. Vacuumizing plus treatment with nitrogen also improved the keeping quality of the juice while treatment with carbon dioxide tended to produce a carbonated taste at the start followed by the development of an undesirable taste after two or three days storage. As a matter of fact the differences between untreated, vacuumized and nitrogen-treated juice were small and difficult to evaluate though it was clear that the vacuumizing did aid in the retention of the natural flavor. The use of milk bottles as containers for properly treated juice was very satisfactory.

In addition to determining the effect of treatment on taste some bacteriological work was carried out. It was thought that the development of microorganisms in the stored juice might be so great as to offer a bar to the use of the process. Counts were therefore made of bacteria, yeasts and molds at twenty-four hour intervals for seventy-two hours and then a final count at 168 hours. At thirty-two degrees F. no increase in the count was found even after 168 hours. At forty-two degrees no increase was found at the end of seventy-two hours but the count had increased about ten-fold at the end of 168 hours. The indication was that at ninety-six hours the count would still have been very low in juice stored at forty-two degrees F. At forty-eight degrees F. there was only a small increase in the count for seventy-two hours but at 168 hours it had tremendously increased. At fifty-four degrees F. the count had trebled in forty-eight hours and increased to more than thirteen times the original count at the end of seventy-two hours and it may consequently be

concluded that this temperature is too high for prolonged storage though quite safe for twenty-four hours, little increase having taken place in this period. The above experiments were carried out on untreated juice but juice treated with carbon dioxide showed a sharp decline in the counts throughout a week's storage at thirty-two degrees and forty-eight degrees F.; probably due to the presence of the carbon dioxide. Further work to study the effect of the vacuum and nitrogen treatments on the bacterial count will be carried out.

It would seem easily possible to juice the fruit after a preliminary precooling and then strain and cool the juice, treat it with vacuum to remove the air and then possibly treat it with an inert gas such as nitrogen, place it in milk bottles and keep it on storage at temperatures below forty-eight degrees F. for seventy-two hours. Such a process would be highly adapted to large dairy companies delivering milk to homes direct. It should be possible to extract and bottle the juice and deliver it cold on the doorstep in less than twenty-four hours. It could then be consumed with the morning meal or kept for twenty-four hours to forty-eight hours in a good icebox. In addition to the above, those milk companies delivering milk to restaurants, sweet shops, juice stands and similar establishments having good refrigeration available would find such a procedure valuable. If the juice were delivered to the retailer at a temperature below forty degrees F. and kept below that temperature a period of forty-eight hours would be available in which to dispose of it.

It goes without saying that great care would have to be exercised in the extraction and handling of the juice in order to keep initial bacterial counts low and in order to give a product with the proper keeping qualities. The success of any such venture will depend fundamentally on the excellence of its product. Poor methods would be disastrous not only to the particular producer using them but also to others engaged along the same line in the same district. With handling equal to that used in connection with milk products by the better dairy products organizations there should be no difficulty along this line and the keeping quality of the bottled juice should compare favorably with that of milk.

Howard Phillips: I would like to take exception to one remark regarding canned orange juice in particular. We have had considerable experience with canned orange juice, extending over a period of some six years. I don't know whether the experimental station has ever had any orange juice put out by Dr. P. Phillips or not, but it is now in its third year of successful commercial selling; whether or not it is equivalent to the fresh juice I can only say that in the markets we have sold in, the response to our sales efforts has been most encouraging, and we have been getting repeated and increased business continuously. That its taste is good must be evident, because of the repeat business we are getting. It is a canned commodity, yet in its Vitmin A content, it is equivalent to fresh fruit. As to its taste, we have to leave that to the consumer, but we have kept up two years without showing any appreciable change.

Dr. Camp: You will agree with me that this year there is less canned orange juice being put up, I think.

Howard Phillips: Generally—you are quite right. I think we are the only people putting up an increased amount of orange juice in the State. I understand other canners have decreased their output of orange juice considerably, or discontinued it entirely, but we have increased it to the fullest extent possible, putting up every ounce we could.

Dr. Camp: If you are increasing it, you are the only company I have on record showing an increased output of canned juice. There are one or two new companies coming into it, but most of the canners are not putting out orange juice this year.

L. B. Skinner: Aren't they being tied up with the milk proposition? Doesn't that complicate their situation?

Dr. Camp: It may be.

L. B. Skinner: With the National juice people the difficulty was the eternal dissensions they

had with the milk people objecting to their robbing them of the marketing of the milk, and these two companies have not pushed the sale of it on account of that.

Howard Phillips: Isn't it due largely to the difficulty they had in marketing? We had a decided reaction against the frozen commodity, in comparison with the present product.

Dr. Camp: I think the matter of convenience is one difficulty. I wrote a number of men in the north about that, and that's one of the common criticisms. The people interested in this sort of thing are primarily dairy people, and they seem to want something to deliver with the milk, to expand their dairy work.

AGRICULTURAL EFFICIENCY AND NATIONAL PROSPERITY

Chas. J. Brand, National Fertilizer Association
Washington, D. C.

Taking agriculture as a whole, there is nothing that we can say at this moment that is very cheerful. It is probably fair to say that Florida and California, because of the diversity and specialization of their agricultural industries, have borne the depression since 1921 on the whole better than any other sections of the United States.

It is always a pleasure to come to the State of Florida, not only to make speeches as I weakly permit myself to do from time to time, but at other seasons in order to benefit from your great out-of-doors in winter as so many thousands and hundreds of thousands do every year. Then too, the old Biblical phrase, "Where a man's treasure is, there will his heart be also," applies to me in common with many other American citizens. Much of my Florida treasure is planted in the Sanford district, and when I tell you that it was planted in 1925 and 1926 and that I wrote oft my losses on it in 1929 and 1930, you will see that my interest in Florida not only has been pleasant but also will be permanent.

My interests in Florida fortunately are not all of this kind. For more than a decade I have been interested in one of your important fruit-growing and fruit-marketing enterprises, American Fruit Growers, Inc., of which I was the first vice-president and general manager. Then too, the fertilizer industry which I now have the honor to represent in its national and organized capacity, is one of the important industries of your state, paying between $400,000 and $500,000 in yearly taxes. At this time our president is a Floridian, Mr. Bayless W. Haynes, of Jacksonville, who is present tonight. In a survey that our organization carried on a few years ago it was disclosed upon the testimony of your own growers that for each $1.00 spent for fertilizer they received a return of nearly $2.50.

The agricultural authorities of your state have been working earnestly for years to improve its agricultural status, and they have achieved striking results. Nothing is more encouraging than the way Florida has come back from the sad deflation that struck her six years ago. She has met storm and pestilence, in the form of a great weather disaster and a most threatening insect pest, standing up and has come out victorious.

Her agricultural problems continue great but perhaps not as difficult as those of the wheat, cotton, corn, tobacco and other important general farming industries of the nation.

There never was greater need for constructive thinking in connection with farm problems than there is today. And I refer not only to the individual farmer but to farm leaders, particularly those whose duty it is to shape our national policies.

In the first place we need to adopt a definite policy on the use of land. We should admit that we have too much land under cultivation for our present needs and do something about it. Except as disclosed needs require, we should call a halt to spending money on unnecessary irri-

gation and drainage projects and begin to make plans for transferring large areas — several hundred million acres — of marginal farm land to reforestation, park and recreation projects. We should correct the long-taught fallacy that all land should be utilized either for growing crops, for grazing or for growing timber. There is no more reason for using all our land at any one time than there is for drilling all our oil lands, or opening all of our coal deposits. The present condition of the coal industry shows what economic disaster comes from over-development. Our new land policy, however, should protect our land resources insofar as it is practicable to do so, in order that they may be available for future generations.

BRIEF REVIEW OF AGRICULTURAL CONDITIONS SINCE THE WAR

In 1919 the gross income of agriculture was about $17,000,000,000. This is the highest of record in the history of the United States. In 1929 it had decreased to almost $12,000,000,000; in 1930 it had dropped to $9,300,000,000, a loss of about $2,600,000,000; and in 1931 it witnessed a further drop to $6,900,000,000, which was twenty-six per cent less than 1930 and forty-two per cent less than 1929, or a total decrease from 1929 to 1931 of $5,100,000,000. You will observe that the 1931 income was about one-third of the 1919 income.

But that is not all. In the interim farm expenses have continued high and some have even increased, particularly taxes and in some cases freight rates. Agriculture has been courageously meeting its problems. Individual farmers under stress of necessity have cut their costs and perhaps the most encouraging thing in the present situation arises out of a comparison of the present depression in other industries compared with agriculture. Agriculture certainly has gone further down and has suffered through a period of nearly twelve years, during at least ten of which other industry throve as it has never thriven before in the history of the world. This thriving, in my personal judgment, has too frequently though not purposefully taken place at the expense of agriculture. Cheap raw materials for food and clothing have been an important factor in the economics of production of manufactured goods.

It is estimated that there are 8,000,000 idle laborers in the United States. The steel industry is working at twenty-one per cent of normal. There have been more bank failures in the past twenty-four months I believe than in the preceding twenty-four years. Happily for the time being at least, despite the fact that commercial failures are very numerous still, bank failures dropped so that there were only six during the latest week; and only fifty-one in March and twenty-five thus far in April compared with a total of 361 for the month of January. Railroads have lost in revenue freight tonnage and in passenger traffic. The securities of practically all corporations have suffered enormous declines, heart-breaking to their holders.

How unprofitable the fertilizer industry has been is readily reflected in the diminished value of its stocks listed on the New York Exchange. It dramatizes the story a little to tell you that when Thomas Fortune Ryan, the great copper magnate, died three years ago, he owned $538,000 worth of the stock of one of the largest fertilizer companies. When his will was probated a few months ago, the value of this stock was only $18,500. Today it has depreciated still further.

We can take some encouragement out of the fact that many American industries have taken their share in the deflation. Later I shall have something to say about some factors in our economic life that have not participated and which probably must participate before we shall have laid the foundation for a true recovery.

HOW EFFICIENT IS AMERICAN AGRICULTURE?

For uncounted centuries farming was a hand industry. Then animal power came to be used; then simple machines, and then during the past 100 years, the mower, the reaper, the threshing machine, the combine, the tractor and other implements, denoting a mechanization of farming, made their appearance. With this growing mechanization there has been a wonderful increase in farm efficiency. Sometimes some people, per-

haps too industrially-minded, are prone to deprecate the progress that agriculture has made. They do not deprecate as much as they did three, four, five and even ten years ago, for when the goose hung high in other industries, and farming was flat, it was quite the style to blame the farmer himself for this condition. Ten years of continued depression in agriculture finally had their inevitable effect, together with certain international complications, in dragging down the whole level of economic life. Farmers have suffered so long that recently some wise-cracking paragrapher commented to the effect that they must long for the old days when they had enough money to buy an occasional gold brick.

The very growth of efficiency in farming, particularly that due to mechanization, has reacted at least temporarily to increase its difficulties. By way of illustration, between 1910 and 1930 the horse and mule population of the country dropped 5,000,000 head. Assuming that it takes about three acres of crop land to feed a work animal, this put 15,000,000 acres of land into disuse, or made it available for other crops of which production may have already been sufficient.

Some may feel that the farmer has not acted wisely in failing to reduce acreage accordingly. Such a conclusion would be rather unthinking, for between 1914 and 1929 the wheat acreage of Ohio, Indiana, Illinois, Missouri and Minnesota declined from 13,600,000 acres to 9,200,000; but other states, more intimately dependent upon wheat production were forced, in order to live, to increase their acreage from 20,000,000 to 33,000,000, and the areas in which the increase took place such as Texas, Oklahoma, Kansas, North Dakota and Montana, were the ones in which wheat growing has become most thoroughly mechanized. It would certainly be unjust to blame either the farmers in the area that showed such a notable reduction or in the area that showed an increase for meeting their economic problems as they did.

The situation reminds one of the vociferous recommendations for diversification that appear from time to time, but which were particularly evident in the Coolidge administration. Everyone from the President down told the farmer that he ought to produce more poultry and dairy products, raise more livestock, and so forth. The result is that today the farm price of eggs is about ten cents, where the average for the five pre-war years was twenty-one cents. Hogs are about $3.90 a hundredweight, where the pre-war average was $7.25, and similarly with other things.

The total acreage of cotton has increased, but the cotton growers of South Carolina, Georgia and Alabama decreased their acreage nearly 2,500,000 acres, while the Texas and Oklahoma planters expanded their acreage between 7,000,000 and 8,000,000 acres.

Agriculture in a great continental area like the United States is not a simple problem to be solved by the dicta of inexpert persons ranging from the grocery boy to the President of the United States. Neither will its problems be solved by those who take an unsympathetic view.

With these comments on the problems of agriculture in general, let us examine just a few of the things that have been accomplished in the way of agricultural progress and increased efficiency.

Much as we may deplore over-production at the present moment, fundamentally, we shall never enrich ourselves by under-production. The following represent the directions that progress has taken during the past century:

1. Expansion of agricultural area.
2. Increased yields per acre.
3. Increase in the efficiency of feeding and caring for farm animals.
4. Substitution of mechanical for animal power, releasing both acreage and man power.
5. Breeding of better strains of crops and changing in given areas from less productive to more productive crops.
6. Increased production of live stock, dairy and poultry products, without rateably increasing animal population.

Merely to picturize the situation a little, we may say that cow testing, the "better sires" cam-

paign, and similar activities have produced astounding increases in both the quality and quantity of our livestock products. The average production of our dairy cows, due to better feeding and better breeding, has increased from less than 3,000 pounds to over 4,500 pounds of milk per animal. The relation of crop acreage to number of farm workers has gone up from nineteen acres in 1880 to approximately thirty-five acres at the present time. Wheat production per worker has increased from about 11,500 pounds in 1870 to over 25,000 pounds per worker at present.

We may say, therefore, with complete confidence, that agriculture has met its modern problems with a striking degree of efficiency, thanks to the leadership of the United States Department of Agriculture, the State Agricultural Colleges and Experiment Stations, and to the educational activities of the extension forces, and farm press and other helpful agencies.

EFFICIENCY IMPERATIVE BUT NOT AN EXCLUSIVE CURE

The average farm income of the State of Florida for the only period for which I could conveniently locate it, namely the five years from 1924 to 1928, was estimated at $1940 per farm. The average for the other ten Southern States for the same period was $1105. This perhaps is a sufficient indicator of the climatological and other advantages that your state enjoys. You are likewise engaged in growing special crops, particularly citrus fruits and truck. You do have some foreign competition, but taken as a whole, annoying as it may be from time to time, it does not compare with that of the producers of the great export crops such as cotton, wheat, corn, hog products and tobacco, although you too have foreign tobacco competition.

Prices have receded in a manner and measure wholly beyond the control either of the individual farmer or of the farm organization, be it of local, regional or national coverage. It certainly is not the farmer's fault that where a few years ago 100 bushels of wheat would buy a mowing machine it now takes 250 bushels; nor that it takes the product of a whole acre of wheat to buy one pair of shoes. Neither is it his fault that a horse that was worth $144 in March, 1910 to 1914 was worth only $62 in March, 1932.

Other factors, both nation-wide and world-wide in their incidence, are playing upon the farmer. The manufacturers of many products have to a great degree been protected by the tariff from these adverse outside influences. We have not yet devised a suitable instrumentality for taking care of the farmer. Some of us in 1923, 1924 and 1925 thought that we had devised such an instrumentality in the so-called equalization fee and equalization fund carried in the famous McNary-Haugen bill which was twice vetoed by President Coolidge. I am one of those who still believe that had such a device been adopted at that time, it would have postponed the inevitable post-war depression in which we are now bumping along the bottom, and it might even have largely — though nothing could have wholly — obviated it.

After the Napoleonic wars and after the Civil War we had the same price history that we are now suffering with. There is no reason to doubt that the destruction of war brings depression in due course.

There are some who contend that nothing artificial should be done to help the farmer. Among business men this doctrine is not as popular as it was a few years ago, for what could be more artificial than the invaluable and practically indispensable work that is now being done by the Reconstruction Finance Corporation? Railroad executives who believed the equalization fee plan for dealing with export surpluses was unsound, paternalistic, un-American and what not, are not hesitant about applying to the R. F. C. for loans to pay their bond interest and even current debt at the present time. The man with a job finds it hard to understand and sympathize with the problems of the one without a job, even though he means to be ever so fair. Some even contend that nothing can be done to help the farmer in this situation.

In this connection I was struck with what France has apparently found it possible to do, as

evidenced by the prices of her wheat for the three last crop years. The maximum price for the crop year that ended in July, 1929, was $1.68; the minimum $1.56; for the year that ended with July, 1930, the maximum was $1.66; the minimum $1.31; for the year that ended with July, 1931, the maximum was $1.91 and the minimum $1.64.

For the same three years the price of the No. 2 contract grade of hard winter wheat at Kansas City was for the year ended June 30, 1929, maximum $1.20; minimum $1.01; for the year that ended June 30, 1930, maximum $1.25; minimum 89 cents; for the year that ended June 30, 1931, maximum 80 cents; minimum 66 cents. Think of the French farmer receiving for his last year's crop from $1.64 to $1.91, while the American farmer received from 66 cents to 80 cents.

There is no time to discuss what might be done. In fact some of my friends in the agricultural world have felt that I deserted the farmer when I took up my work for the fertilizer industry. This is not true. I have the same sympathy and interest, and from time to time I find some opportunity to continue to be helpful with respect to the broader phases of the agricultural problem. Aside from this it is my firm conviction that commercial plant food represents one of the most important ways of meeting the problem.

REDUCING PRODUCTIVE COSTS AND IMPROVING QUALITY

The net income of the farmer depends just as much, in many cases, upon his costs of production as it does upon the prices he receives for his commodities. Commercial plant food represents a great opportunity for reducing costs.

In 1928 our Association made a survey in which 1,000 fertilizer salesmen visited and interviewed over 48,000 farmers. They learned many interesting facts, perhaps the most striking of which was that on the farmer's own testimony he received an average return of $3.54 for each dollar spent for fertilizer.

Each pound of fertilizer applied to cotton produces an additional pound of seed cotton.

Your citrus growers know that with an average production of less than 150 boxes per acre, some growers make from 500 to 1500 in extreme cases. Adequate and intelligent use of fertilizer is very frequently the answer.

In the valley of the Red River of the North in Minnesota last year a potato grower made eighty bushels of potatoes more on his fertilized than on his unfertilized acres. His fertilizer cost $8.00 per acre, or ten cents per bushel of extra crop.

EQUITABLE EXCHANGE RELATIONS

The great problem of agriculture, next to achievement of those efficiencies that may be designated by that broad, inclusive term, "better farming," is to obtain better prices. There is a justice that is owing to every service-rendering element of our national population. It is trite to say that farming is an indispensable industry. If the farmers had the same urge to "strike" that industrial labor shows from time to time, we can easily vision the destruction that would occur; but several million farm-owning persons are very unlikely to go on a strike that would destroy not only their means of earning a living but the value of their assets laid up for their own mature years and for passing on to their children.

Based upon the average prices of all farm products, the exchange value of the farmer's dollar at the present time is only fifty-one per cent of its five-year pre-war average. The five pre-war years were moderately prosperous years in agriculture, and only moderately prosperous. In fact, during only three of those years was there an excess in the index number of farm commodities compared with all commodities.

I have often said that renewed prosperity must come largely from new wealth produced by the extractive industries, and particularly agriculture. I do not wish to minimize the importance of mining, forestry and oil drilling, nor the effect that the supply and production of gold has upon prices, but taken broadly, prosperity will return when ample crops at fair prices have been

produced for a sufficient period of years to renew national purchasing power.

The fifty-one cent dollar of the farmer is the greatest single explanation of the unemployment that exists at present in other industries. I am not overlooking foreign debts, reparations, excess cost of government, both state and national, and all of those other factors, but I lay it down as a general principle, based upon my economic studies and upon my own observation of the period that followed the panic of 1893, that we shall have renewed national prosperity as soon as we have renewed agricultural prosperity and no sooner.

We had an illustration of this last autumn when for a few weeks wheat and cotton prices advanced steadily.

Immediately there was a minor bull stock market, and the prosperity which had been just around the corner for so many months, and so elusively, was believed to have been made captive.

Farming is the residual occupation of man. Every industrial depression produces its back-to-the-farm movement. On the farm the individual can by ingenuity, shrewdness, prudence and hard work, eke out a living as he can do in no other place. Nominally other industries have advantages, and usually, advertently or inadvertently, they take advantage. The economic struggle between great classes of population is just as real as the competition between individuals engaged in a given line of commerce.

When the exchange relations of the farmer's products return to a normal and fair basis, we shall witness an astounding reversal from our present low ebb of national prosperity. At the present time the index of wholesale prices of all commodities stands at approximately ninety-seven. The index number of prices paid by farmers for the commodities they buy stands at 121, while the index number of all groups of farm products stands at sixty-one. The ratio of prices received to prices paid is therefore fifty-one.

There are about 6,500,000 farms in the United States. Each farm family has an average of five persons. Agriculture thus involves about 32,500,000 persons or twenty-seven per cent of our total population of nearly 124,000.00. Because of the inherent difficulties of organizing agriculture, it is practically always at a slight price disadvantage with other groups, but until normal equitable exchange relations for agriculture return, there will in my judgment be no sound basis of prosperity.

SOIL UTILIZATION AND CONSERVATION

Because of the immediacy of production and price problems, we are sometimes prone to overlook the long-range importance of agriculture. We all recognize that farming has a number of phases. First, of course, it is a business and as such its desirability as an occupation for obtaining a livelihood depends upon its annual net income. It is also a mode of living and as such its desirability depends upon those less material but nevertheless altogether real satisfactions that come from country life. But for a nation to depend upon a large faction of its pepole continuing to serve its needs because of immaterial satisfactions certainly wounld be unsound and in the end disastrous. Perhaps the best way to make the point of the fundamental importance of agriculture is to say that only farm families and foreign urban families, many of them of the lower grade, have families averaging five members. Even with agriculture at the low ebb that has existed since the repeal of the corn laws in England in 1847, Lloyd George a few years ago stated that this industry furnished the best life blood in the British commonwealth.

As matters now stand, the lack of prosperity in agriculture results in a neglect of the great problem of soil utilization and conservation, the solution of which requires long-range programs, involves deferred income, and demands a far-seeing national policy. During the past fifteen years, due probably as much to the leadership of the U. S. Department of Agriculture as to anything, there has been a growing recognition of the necessity of working out and following a constructive program of soil utilization and conservation. There is not time for me to discuss this problem, despite its fundamental im-

portance. I can only indicate its economic inferences by stating that every year the removal of crops, the leaching due to soil solutions, and the loss by erosion deplete our crop lands of 4,250,000 tons of nitrogen, 4,350,000 tons of phosphoric acid, and perhaps as much as 28,500,000 tons of potash.

	Nitrogen	P_2O_5	K_2O
Loss by cropping	3,500,000	2,000,000	5,000,000
Loss by leaching	250,000	350,000	3,500,000
Loss by erosion	1,500,000	2,000,000	20,000,000
	4,250,000	4,350,000	28,500,000

The efficiency and value of many of our crop lands have already been gravely reduced and their depletion is proceeding at an accelerated rate. In the few hundred years that cultivation of the soil in America has been under way, it is estimated that 18,000,000 acres have been rendered uncultivatable by gullying. Students of the question estimate that another century will see a full 100,000,000 acres practically destroyed by erosion.

EQUALIZING THE EXPENSE BURDENS OF AGRICULTURE

Not only must the expense burdens of the farmer himself be reduced, but despite the great deflation in wholesale prices that has already occurred the expense burdens of millions of the farmers' customers must be brought down, in certain respects, if they are to be better customers for the farmers' products.

If I were speaking in a dairy country I would emphasize by way of illustration the question of milk prices. Every one now recognizes the utility of milk in the preservation of child life and health and its importance to adults. In Washington we pay fourteen cents per quart for the usual grade of milk; in Pittsburgh the same grade costs nine cents; in other cities it costs less; and there was a time during the winter when the price of milk to producers in the New England milk shed was as low as three cents a quart, so that the Mayor of Boston called a mass meeting to focus the attention of his people upon the inevitable results that would occur later unless the farmer could be reasonably compensated for this indispensible fluid.

Restoration of *prosperity* depends upon the restoration of *parity*.

Building construction will not increase on a large scale while the index number of building materials is 133 and that of farm products is sixty-one. The farmer cannot afford even to repair his building properly wtih such a disparity. Consequently construction labor will not be employed.

Factory products will not be bought in the measure that they could be while industrial wages bear an index number of 189 while farm products stand at sixty-one.

It is my custom to say, and I am convinced that it is a sound and defensible statement, that at least five groups of factors must be brought into a reasonable parity with farm prices before we can feel sure that we have struck bottom and laid the foundation on which to build a restored prosperity. These five are:

1. Lower taxes with concomitant decreased cost of government.

2. Lower wages in some industries where labor cost represents too large a part of the total and where, despite extensive unemployment, wage rates are still maintained at unduly high levels.

3. Lower freight rates, for sixty-cent wheat cannot pay the freight cost that $1.00 and $1.50 wheat did, any more than four-cent pork can pay the high freight levels of the post-war period that seven-cent pork paid in the lower freight costs in the pre-war period.

4. Lower retail prices for many commodities, despite the fact that retail prices on a large number have already shown a great degree of adjustment.

5. Lower rents in cities where the cost of housing in many areas mortgages too large a part of the reduced earnings of customers for farm products.

In this time when government revenues and taxes are subject to such intensive and sometimes acrimonious discussion, it is worth while to re-

member that if the total taxes paid on all farms in 1914 be taken as 100, the tax in 1919, the year of the largest farm income in all history, was only 130, whereas today when the farm income has dropped from $17,000,000,000 to less than $7,000,000,000 farm taxes stand at 266 compared with 100 in 1914.

My time is more than spent. I wanted to say something specific regarding the citrus and truck industries and particularly regarding the relationship of my own industry to increased prosperity of citrus and truck growers that may be achieved through the intelligent and adequate use of commercial plant food. I can only conclude by saying in summary that for the long run and for the short run the following factors, among many others, must be given due attention in order that agriculture may contribute its full share to the restoration of prosperity:

1. A sound comprehensive national policy of land utilization and conservation. We are using our lands unwisely and in addition erosion is washing away hundreds of millions of dollars worth of soil every year.

2. More efficient and less costly marketing and distribution of farm products. Private marketing corporations, co-operative marketing associations, the Federal Farm Board and other agencies are helping *some* toward this end. This problem is far from solved.

3. A business-like instrumentality that will enable us to dispose of our export surpluses with such orderliness that the one bushel of wheat in six or seven or the one hog in ten that are normally exported will not be permitted to fix and determine the domestic sales price of the whole production.

4. Last but not least, we must have a far more general adoption of "better farming" with all that term implies, particularly soil conservation and soil improvement by the intelligent and abundant use of balanced, modern commercial plant foods and the use of efficient machinery.

THE AGRICULTURAL WORK CENTERED AT THE UNIVERSITY

Dean Wilmon Newell, College of Agriculture, University of Florida
Gainesville

It has been many years since this Society held its meeting in Gainesville. During that time many interesting developments — and some sad ones — have taken place in Florida.

During the same period also there have been striking developments here in the University. While the campus has been enlarged and many buildings added, the developments and growth within these walls have been even more striking and significant.

What you, as horticulturists, are perhaps most interested in are those activities, centered here, which have as their sole purpose the rendering of service to you and your industries, and perhaps this is a propitious time to place before you a brief picture of what these activities are and what they accomplish.

These activities are of three types — educational, constructive and protective.

The educational, again are of two types — education of the students who come here to master the sciences which are basic to agriculture, and educational help for the rural farm population of the state.

The former is handled by the resident Teaching Division of our College of Agriculture and the latter by the Extension Service of the College.

The Extension Service is best known to you through the work of the County Agents and County Home Demonstration Agents. They are teachers, teaching by lectures, by conferences, by literature and by demonstrations, helping the citizens of the state to apply in a practical way the new information constantly being brought to light by the Experiment Station and making available the vast storehouses of information in the

College of Agriculture and the United States Department of Agriculture.

But agriculture is a progressive, growing thing; what was good yesterday is antiquated and insufficient today. The new problem or difficulty of today must have a solution tomorrow. Unless we are to stand still — and standing still means going backwards — we must ever be searching for new agricultural knowledge, seeking it systematically and methodically and with the certain assurance of finding it. Therefore, we have the *Experiment Station*, the fountain of new agricultural knowledge and the constructive agency in creating new values.

In a state like Florida, with its sub-tropical conditions, a state almost surrounded by islands and countries harboring dangerous pests and plant diseases, it is not merely sufficient to build and to educate. The agricultural industries, established by the application of scientific knowledge and the hard work of our citizens, must be protected — protected by plant quarantines and by eradication activities when perchance a dangerous enemy succeeds in crashing the gates.

It is a pleasure to say to you that all of these activities, for the eleven years past, have been conducted in close co-operation with each other, separate yet efficient, and without duplication of effort and with the minimum of expense.

The next five speakers will place before you some of the essential activities in each of these three fields — educational, constructive and protective — and endeavor thereby to give you a comprehensive picture of the agricultural activities centered here and in which you are vitally interested.

THE AGRICULTURAL COLLEGE

Teaching Division

W. L. Floyd, Assistant Dean

In 1870 the Florida Agricultural College was provided for by the State legislatures to take advantage of the Morrill Act of Congress granting public funds for providing colleges for the benefit of Agriculture and Mechanic Arts. After delays and efforts to establish the College in different places it was finally located at Lake City and opened for students in 1884. It was operated under the name Florida Agricultural College till 1903 when the name was changed by the State legislature to University of Florida. In 1905 it, along with the five other institutions of higher learning, was abolished by the Buckman Act. Its physical equipment and records became a part of the newly created University of Florida located in Gainesville.

The College was organized as one of the distinct college units of the University in 1910. It is usual in discussing enrollment, degrees conferred and other accomplishments to start from this date as the records are incomplete back of that and the accomplishments along agricultural lines rather meager.

Since 1910, the degree B. S. A. has been conferred on 258, that of M. S. A. on twenty-seven men and agricultural training given to about forty others on whom the degree B. S. in Agricultural Education has been conferred by the College of Education.

The teaching staff consists of twenty instructors, seven graduate assistants, a farm foreman, and a herdsman.

These are divided into eleven departments, each headed by a man holding either a Doctor's or a Master's degree. Research work such as time permits, on problems of practical interest, is carried on in addition to the main work of teaching.

A farm of 145 acres is operated primarily for instruction purposes. It is equipped with a farm foreman's house, general barn for work stock,

modern dairy barn, silos, beef cattle barn, veterinary hospital, potato storage house, corn crib, fertilizer house, machinery shed, greenhouses, poultry houses, stock lots and sheds and a number of types and breeds of farm animals. The larger Experiment Station farm is also available for observation and special studies.

An important feature of the curriculum is that a student not later than the beginning of his junior year decides in what department he will major. The head of that department then becomes his adviser, helping him determine what options and electives he should take to become best trained for his life objective. He may enter Agricultural Economics, Agricultural Chemistry, Agricultural Engineering, Agronomy, Animal Husbandry, Dairying, Botany and Bacteriology, Entomology and Plant Pathology, Horticulture and Landscape Designing.

The enrollment this year is 236, four more than that of last year; five graduated at end of first semester; twenty-five are candidates for degrees at end of the session in June.

Although difficult to determine accurately, it is estimated that of the graduates twenty per cent are farmers or fruit growers, twenty-seven per cent engaged in special agricultural work such as demonstration agents, state or Federal inspectors, research workers, etc., fifteen per cent agricultural teachers, a total of sixty-two per cent which is large as compared to most other states.

Students eighteen years old or over are allowed to enroll as special students and permitted to take such studies in practical agriculture as the Dean on consultation approves. A small number from other states coming or recently come to the state enter each semester to remain one, two or more semesters as well as a number of mature students from within the state.

We are making an earnest effort to train the young men who come to us to better aid in developing the agricultural resources and bringing about a more profitable utilization of the products of the state.

THE AGRICULTURAL EXPERIMENT STATION

H. Harold Hume, Assistant Director in Charge of Research

One of the most interesting things in Florida in Agriculture is the number of crops that are grown, and the source from which they come. Our citrus fruits come to us from Southeastern Asia; Avocadoes from the Tropics of the New World; Mangoes from Indian and Algeria; Persimmons from the Orient; Peaches from China (North and South, two separate groups); Grapes from Europe, from North and South United States; and Strawberries from the west mountain regions of both North and South America.

Of our field crops, corn probably came from Mexico, but it was here in Florida when the white man came. The Indians had started its cultivation before the discovery of America. Tobacco, too, is an American crop; it came from further South, and it too was grown here when the continent was discovered. Sweet potatoes came from the American Tropics, Peanuts from Brazil.

Of our truck crops, Irish Potatoes came from the Andes Mountains, Peru and Chili; tomatoes from Western South America; Watermelons from South and Tropical Africa; Egg Plants from South Asia; Celery from the British Isles, from the beaches and marshes; Cabbage from West England; Lettuce is widely European; Cucumbers come from the warm countries of Asia and Egypt; Beans from Mexico; Carrots from the British Isles, and Beets from the seacoasts of Southern Europe.

We have had many plant enemies brought into the State, and then we have undertaken to grow these plants under an entirely different set of conditions to which they have been grown. Most of these plants start their growth in the spring,

and grow under an ascending temperature. We plant mostly in the fall, and attempt to grow them under more or less constantly decreased temperature. Out of the cultivation of all of these crops in the State of Florida have come many problems in connection wtih their culture, and in connection with their production. That is the reason for the Florida Agricultural Experiment Station, because it is not given to any single individual in the State of Florida of himself to solve the problems that arise in the cultivation of any one of these crops which I have enumerated — much better that that should be done by a group of men who give their attention to nothing else, and who perhaps in some of the offices, at least, are not particularly concerned in the results of production.

The Agricultural Experiment Stations of the United States, as a group, were started about the year 1888, and the Florida Agricultural Experiment Station came into existence in that year. It was located at Lake City until the transfer of the University to this point. Now then, of these Experiment Stations of the State, we have several. We speak of the Agricultural Experiment Station of Florida; as a matter of fact, it is a group of Experiment Stations rather than a single one. There is the main station here at Gainesville; there is the station in North Florida at Quincy, the ones at Lake Alfred, Belle Glade and Homestead. In addition to these are the so-called laboratories — the one for Watermelons at Leesburg; the one at Bradenton for Tomatoes; the one at Cocoa for Citrus Wilt; the one at Plant City for Strawberries, and the one at Hastings for Potatoes. Each of these is manned by a force of its own.

The work is divided into several departments: The Department of Agronomy with W. E. Stokes at its head; the Department of Chemistry with Dr. R. W. Ruprecht; the Department of Agricultural Economics with Dr. C. V. Noble; the Department of Home Economics with Dr. Ouida Davis Abbott; the Department of Entomology with Dr. J. R. Watson; the Department of Animal Husbandry with Dr. A. L. Shealy; the Department of Horticulture with Dr. A. F. Camp; the Department of Plant Pathology with Dr. W. B. Tisdale.

The Spaniards probably brought the first cattle to the State of Florida, and some of them got sick under certain conditions. There came about a peculiar unknown disease commonly called salt-sickness. It was one of the first problems tackled by the Experiment Station of the State, and from that time down to the present intermittently, because the tackling of this problem was not continuous, until this past summer, that problem was not elucidated, and it is an example of continued effort in a single field that finally offered solutions. Some of you are confronted by problems in the growth of your crops. You may think it easy for someone to step in, and say "This is the matter," and "This is the solution of your difficulty." Far from it. Sometimes the solution of the problem must wait upon new methods, upon new equipment, before we can arrive at a solution of it. But finally the cause of salt-sickness and how to handle this peculiar anemia of cattle has been solved. I presume from the beginning, that the Experiment Station of the State has spent about $30,000 on that problem, and I am safe in saying that in the cattle industry as it stands today, it is probably worth to the State of Florida if the cattlemen will apply it, three million dollars per year. I maintain that our investment in that one problem of $30,000 has brought or will bring returns in the future. The whole difficulty may seem very simple when we know all about it. It simply means feeding cattle as part of their ration, or placing it where they will get it, a mixture of copper and iron, and fifty years from now when this whole difficulty is cleared up, the people of the State will have forgotten all about it, and nobody will erect monuments to Krome, Becker, Neal and Shealy, for working it out.

The incident which brought the North Florida Experiment Station at Quincy into existence was this. The growing of tobacco is an important industry in Florida; the gross output is about one quarter of a million annually. In 1921 or sometime prior to that time, the tobacco growers of Western Florida found themselves confronted by a very serious disease. That disease disappeared

to return again this year, but it was sufficient to bring that Experiment Station into existence, and it was found when the situation was further looked into that there was a much more serious disease at work, commonly known as Blackshank, which would have absolutely wiped out the whole industry, and wiped out many tobacco growers. As a result in the breeding of new tobacco varieties it is now possible for that industry to go on its way without fear from this disease, and to produce satisfactory crops on lands that were previously unprofitable. It is one of the outstanding things in plant breeding and in the solution of a plant disease problem.

When I came into the State in 1899, one of the questions before the people was the draining of the Everglades. Here was a vast area of land, tremendously rich, that could be made the sugar-bowl of America. They said "We will drain it, and have a new Empire, a new Florida." We drained it, and when we got it drained we didn't know what to do with it. We had soil on which we couldn't grow anything. What was the trouble? Two men working through the Experiment Station of the State solved the problem — Drs. Bryan and Allison, who discovered as a result of their experiments that the plants needed copper, and in certain other areas manganese, and now every ton of fertilizer that goes there carries its quota of copper and manganese, as part of the component mixture. Now you can grow things in the Everglades. You can grow sugarcane; and it is richer than the canes of Cuba or Louisiana. You can grow them in greater quantity. And the solution of that problem is one of the very outstanding contributions of the Experiment Station to the welfare of the State.

We are interested in the Everglade problems in another way. We can't grow sugarcane on every acre of the Everglades. If we do, the sugar producers will be poorer than they are today; they will have too much sugar. We cannot turn it all into a truck patch, because we would have more truck crops than we could dispose of. The Experiment Station is turning its attention to the possibilities of live stock production on those soils, and they tell some terrible tales about the number of cattle you can raise on an acre of ground there, and yet I do not believe any area surpasses it in the production of grass. I do not believe four cattle confined in an acre of ground can take care of all the grass that that acre will grow there.

Now then, I am coming to the Entomological problems. You, as citrus growers, are intimately acquainted with citrus aphids, and the work done by Prof. Watson on that problem. You know how to handle it now; you might have worked it out by yourselves, but it would have taken a long time to do it, and you perhaps then may not have reached a satisfactory solution of the problem at all. So it was with the Cotton Cushiony Scale, in days gone by.

I will refer to one thing more. We have been intersted in these Experiment Stations over a period of years, in production problems. The thing we were interested in most was how to grow cheaper and with little effort. We have given but little attention to the marketing of it, but in the Research work of the Experiment Station there is a department devoted to marketing problems in the different phases. One of the outstanding things is that in Dr. Nobles' department it was pointed out that if seventy-eight per cent of the packing houses were as efficient as the other twenty-two per cent, there would be a saving to the grower of twenty-five million boxes of fruit, or approximately one and a half million dollars annually.

The trouble with the whole situation in Florida, as in every other State in the Union, is that the things found out are not taken seriously enough.

Now I do not believe there is any State in the Union where the leads of the Experiment Station are followed more closely than here. This is a service institution. It is here to help you to solve the problems that come up, and while you are sometimes irritated because your problem is not taken up, I might say that I have indicated the number of crops grown; I might indicate the conditions under which they are grown; we have those problems in large numbers and greatly multiplied, and I beg of you to be patient; it takes men, money and time; if we had many more

men, and many more times the amount of money than we have, we could put them all at work to the advantage of the agriculture of the State. I believe Florida's future is tied up inseparably with its agricultural progress. We cannot go forward without it, and when Florida does go forward the Experiment Station will have its part in ithe development of its Agriculture.

AGRICULTURAL EXTENSION WORK BY COUNTY AGENTS

A. P. Spencer, Vice Director Agricultural Extension Service

To keep within the time limit and give you anything like a comprehensive statement dealing with county agent work in this state, I can only hit the highest places and abbreviate very much on them.

We have been conducting extension work under the present plan since 1914 and even before that it was under way. Its purpose is to conduct educational work among people who cannot attend the agricultural colleges. It began as part of the educational system of the University of Florida and the United States Department of Agriculture and to this day it is still educational.

We have a staff of extension workers who have been appointed by the Board of Control and who rank as members of the faculty of the University. They are also representatives of the United States Department of Agriculture and our appointments are approved by its Secretary of Agriculture.

Extension work during the past years has included the entire role in agriculture, horticulture, poultry, etc. For many years production has been considered by casual observers the only activity of the farm demonstration agent. The facts are that standardization, grading and co-operative effort among farmers has been about half of the program.

As a guide for conducting Extension work each Extension agent and supervisor makes a plan on January 1 covering the year's work. This plan of course is intended to fit the county's agriculture. In normal times such a plan might carry on from year to year with very little change but with the present changing conditions it must be varied from year to year. It deals with the important agricultural pursuits of the farmers.

The counties in Northwest Florida have programs for the development of livestock. There was a time in Florida when cotton would have been the main consideration but now farmers must turn their attention to other things. With this in view the county agents have worked out dairy programs to grow necessary feeds, find profitable dairy cattle, then help out in marketing the products. Several hundred dairy cattle have been bought and raised by farmers to build up commercial dairies and many have gone out to individual farmers to furnish the home supply of dairy products. The county agents have worked up co-operative orders for cattle, the extension dairyman has followed up the efforts with good management practices. This has given a distribution of good dairy cattle all through Northwest Florida and while the situation has been discouraging because of the low prices of dairy products, many of these farmers now have good dairy cattle.

Beef cattle production has been emphasized. We have a co-operative arrangement with the Bureau of Animal Industry for beef cattle extension work. Several hundred breeding stock, mostly bulls, have been distributed in the West Florida counties. This has been done partly by the Livestock Sanitary Board and partly by the Extension Service so that now one can see a number of animals with improved blood that should improve the size and quality of the cattle of that section. This project too has met with its handicaps because of the low price of beef.

The Livestock Sanitary Board has done an excellent job in cleaning up the cattle ticks for without that change there would be little use in trying to improve the livestock otherwise. Now the territory is free and there is nothing to prevent the introduction of good stock into that area from almost any section of the country where it can be procured.

In the same area hog production is and has been the best and safest money crop for the farmer so through the boys' club and the county agent work the grade and quality of hogs have been decidedly improved. This is not only a matter of getting better animals but a matter of providing feed. There is little profit unless the farmer grows his feeds and markets his hogs intelligently. County agents have arranged for co-operative sales and regular marketing days. This too has had its ups and downs because of fluctuating prices but even with the present low prices pork production compares favorably with almost any agricultural pursuit of that territory. The marketing of livestock has been a co-operative arrangement between the Extension Service and the State Marketing Bureau.

The farmers of that section have been sowing carpet grass seed and putting in other improved pastures, converting idle lands into permanent pastures.

There are many other details in this program but this is sufficient to present a general program for livestock improvement.

SOIL IMPROVEMENT

It is clear to anyone that we have production problems due to soil conditions. With this in view the extension service has emphasized a soil improvement program. Throughout all north and west Florida a large acreage of winter Austrian peas and vetch have been planted to turn under on land to be used for staple crops. Where the crop was managed properly, this practice has almost doubled the yield of corn that followed. It requires inoculation and must be planted in favorable weather and soil conditions. Several car loads of Austrian peas and winter vetch have been procured in the last three years, practically all bought through co-operative orders. Some years have been more successful than others. In the central and south Florida territory those of you who have passed through the citrus area have observed large acreages of crotalaria planted in groves. This effort has been made for the sole purpose of increasing the productiveness of groves by soil improvement. Formerly the seed was very scarce, costing from $.75 to $1.00 per pound but by co-operative pooling of orders by county agents many tons of seed were brought in from Porto Rico at 16c and this low price has given it a good distribution.

During the last two years the growers have gathered their seed and this year there is an abundance of crotalaria spectabilis for sale. In DeSoto County alone the county agent has fostered the movement and the growers had about eighty tons for sale. This has been a soil improvement program that has been very far reaching and when incomes from groves are uncertain, it is a big help in reducing fertilizer costs. This effort has been sponsored by the Extension Service through county agents and we think it is a good piece of work.

Two years ago we were able to increase the Extension Service by adding an Economics department. This was organized in two divisions, marketing and farm management. The farm management projects are set up to procure records of production including the costs and return. Two extension specialists make their connection with grove owners through the county agents and get the data on active grove management, endeavoring to find out the most economical practices. Considerable data has been collected on this, fertilization, management, costs and returns. This must be carried on several years in order to make it fully authentic, considering the many factors that influence grove production. In the marketing phase of this work, the extension service has not made any plans to duplicate the work of the state marketing bureau but to study successful marketing methods. This work is being pushed because of the large production and unsatisfactory marketing and apparent need of reduced operating expenses for when citrus fruits sell for an average of $2 per box on the tree,

the cost of minor operations are not considered seriously by the grower but with prices that prevailed during the last eighteen months any unnecessary expense must be eliminated to make it profitable.

A study has been made of the harvesting methods of Irish potatoes in the Hastings section by the collection of data from producers.

The farm management has given special attention to the poultry production and has collected many records. The purpose of this is to determine the most economical practices — it is evident a poultry producer must have a sufficient number of birds to warrant the expense of his operations. He must use good marketing practices and follow economical methods in feeding, in addition to having high producing birds.

These studies and this type of demonstration work has been emphasized due to the general depression and it is evident that with the increased production that is found on every hand, the farmers must consider the cost of production more than they have in the past.

I have not discussed the boys' club work, as much of this information has been passed out here-to-fore. In order to carry this on successfully there must be a driving force in the county county and that driving force is the county agent's efforts. Four-H club work has given a stimulation to extension work and has met with the approval of almost every institution. Commercial companies have awarded prizes. Boys and girls have been permitted to spend a week at the University of Florida where they receive special instruction at a short course. The United States Department of Agriculture holds a camp once a year where the picked boys and girls from over the country come together for a week. The extension service has club camps and club rallies at appropriate times. Time will not permit to go further into detail.

The extension service also conducts "Farmers' Week." The attendance has been running from 1000 to 1600 per year. This occasion affords an opportunity for a large number of people to acquaint themselves with the college of agriculture and the university as a whole.

HOME DEMONSTRATION WORK AS RELATED TO HORTICULTURAL INTERESTS

Flavia Gleason, State Home Demonstration Agent, Tallahassee

The Home Demonstration Organization is a part of the Co-operative Extension Service in Agriculture and Home Economics.

In home demonstration work we endeavor to carry the best information available from the United States Department of Agriculture Extension Service; Bureau of Home Economics; College of Agriculture, University of Florida; School of Home Economics, Florida State College for Women and the research laboratories to the rural women and girls to aid them in the solution of some of their many problems in housekeeping and home making.

There are 15,927 rural women and girls who meet regularly at least once each month to receive instruction from thirty county home demonstration agents in Florida.

In the Extension Service men and women are promoting a live-at-home program. The home demonstration part of it deals directly with the home garden, home orchards, the poultry flock and milk supply as a means of good nutrition for the farm family, for increasing the financial income and for developing more abundant living. At this time we will deal with only those phases most closely related to horticultural interests.

HOME GARDENS

Recognizing the need for fresh fruits and vegetables in the diet at all seasons of the year the home demonstration organization mapped out an

educational program in gardening and perennial plantings. One of its important objectives is an adequate supply of fresh fruits and vegetables in every rural home and a plentiful and proper use of these products.

A second objective is the beautification of the Florida home through the planting of the many kinds of valuable economic ornamentals, that can be grown so easily.

The home garden program is especially important. The home garden is more valuable than is often realized in saving grocery bills and in maintaining a healthy family. The garden always makes an important contribution to the farm living. In times of financial stress or disaster it affords invaluable aid to the farm family. How to feed the family adequately? How to make the lessened income stretch to meet family needs? How to keep the members of the family in good health? These questions the well managed garden helps to anwer.

The garden is always a good starting point — a first resource when at the end of a bad year the farmer and his family face the new crop season. Out of the garden must come much of the living until the new crop is sold. Nor is it enough to encourage the planting of gardens by young and old. Extension workers urge insistently the growing of a good garden, the cultivating, fertilizing and working it through the entire season. Fresh vegetables in quantity and variety, a generous table, summer and winter, even in difficult times is what the well-tended home garden gives the farm family.

The home demonstration agents are carrying the perennial planting and gardening program all over the state regardles of the section. They are visiting rural homes, and arousing the interest of the families in the program. Contests are being staged to encourage the women and girls to grow a wide variety of vegetables, and to serve every day in the year fruit and at least two vegetables from the home garden.

Splendid co-operation has been secured from seed dealers, nurseries, fertilizer concerns, Women's Clubs and individuals in promoting better gardens and more perennial plantings. Interest has been stimulated through monthly letters carrying timely information; a utilization score card; garden scores; suggestive canning budget for the family; exhibits; posters; lectures; demonstrations; all-year garden contests; and awards. County Councils composed of representatives from the various home demonstration clubs in the county, have in some instances bought seeds in wholesale lots, assorted them into penny packets and distributed them to club members. This enabled each member to obtain an assortment of good seed at small cost.

The possibilities in growing new vegetables and the opportunities for the enrichment of the diet through the use of new vegetables and fruits are being demonstrated, and the women are eagerly accepting the instructions. At present there are 8,100 women and girls growing home gardens under the direction of home demonstration agents.

CALENDAR ORCHARDS

For several years home demonstration agents have been stressing the growing of calendar orchards. They are using as their guide a plan worked out by Dr. Hume. There is considerably more interest in the calendar orchards than previously. The number of fruit trees planted in the calendar orchards this year exceeded those of last year but the outlay of cash in securing desirable plantings keeps the number from increasing as rapidly as we would like to see it. However, there are 1,611 women who are developing these calendar orchards at present according to the plans mentioned.

Club girls in beginning their garden programs are required to plant at least six perennials during the first year, and it is hoped that by the end of the fourth year the trees or vines planted will be yielding and supplying the family table and perhaps a surplus for the market a little later.

FOODS AND NUTRITION

The home demonstration agents received more calls for information along the lines of foods and nutrition last year than any other phase of our work. Twenty-seven per cent of their time

was given to promoting the serving of well balanced meals, satisfying and attractive foods, school lunches that provide for growth and protection and the need for producing and using Florida products in this way.

In order to meet many requests and to render service to a larger number of people we prepared a bulletin on Economical Meals for Florida Folks, material on Helping Florida Feed Herself and Saving the Surplus. We have not issued more appreciated, timely and usable publications.

The agents are constantly promoting the use of Florida fruits and vegetables and demonstrating ways of putting their recommendations into practice.

Although we do not have a complete report of all of the food conservation work conducted in the state we do know that there has been an enormous number of containers filled with canned foods, pickles, jellies, marmalades, jams and crystallized fruits by farm women and girls, according to budgeted family requirements and by scientific methods. This represents more than just canning for it is fulfilling the Live-at-Home ideal and using the surplus to keep cash spent for food as low as possible. It is evident by requests for information, enthusiasm at demonstration meetings and by the well filled pantry shelves that there has been more attention given to this phase of the work than since during the war, if then. Many of the by-products are being standardized for market thus helping the family with the cash income.

Over a period of several years home demonstration agents have at various intervals sponsored county products dinners. It is interesting to see in this connection that civic clubs over the state have entered into the idea of serving All-Florida Products Dinners as a means of helping to relieve depression and unemployment. A great deal of local pride and interest has been aroused by the county products dinners given under the direction of home demonstration women. Products taken from their gardens, orchards, poultry flocks, dairies and pantries provided excellent food of great variety and proved to the people themselves that we do have a live-at-home program well under way in Home Demonstration Work.

BEAUTIFICATION OF THE HOME GROUNDS

In addition to encouraging the women and girls in growing fruits and vegetables to supply food for rural homes and instructing them in the uses of these foods for best returns in the form of good health we are urging the setting of plants which would not only yield fruit, but would serve as ornamentals. Special attention is given to open green lawns, shrubbery, foundation plantings, yards planted according to a plan, improvement of appearance of the place.

Agents have held plant exchanges, led groups of people to woods for native shrubbery, arranged with nurserymen for special rates for members of home demonstration clubs to pool orders and secure prices that could be afforded, particularly for rose bushes. In one county the rural women have planted over 4,000 rose bushes during the past two years.

The county flower idea has been the chief means for getting every one, women and girls, in home demonstration work to plant flowers and perennials. Each one is expected to have growing about her place the county flower. Special shows for exhibiting the county flowers have created much enthusiasm in the various counties which has spread to others than club members. During the year there were 2,885 women and 4,039 girls who conducted demonstrations in beautifying home grounds. Interesting reports and demonstrations of progress in beautification of home grounds can be found in each county where there is an agent.

By way of summary may I say that we are putting into practice the instructions passed on to us from Dr. Seaman A. Knapp, the father of the Extension Service, in that we try to teach the rural people greater thrift, to raise their own provisions, to can their surplus vegetables, fruits and meats so that they may have them the year round; that they must put their money into a better home, and so percolating and drifting through this home there will be a broadening element and

there will be a gradual uplift of conditions and as there is an uplift and improvement of conditions the people themselves will become a little broader and a little straighter and a little firmer, till by and by this home society where we must live, this rural society, will be a great dominating force in the land, and we shall become a pattern, not only to our own country, but to all countries, showing how a great and free people were able to readjust their conditions.

THE WORK OF THE STATE PLANT BOARD

Dr. J. H. Montgomery, Gainesville

It has been said that constant dripping of water wears away the stone. It might be said with equal force that constant repetition wears away the patience of the listener. It has also been said that constant repetition adds little or nothing to the force of an argument. At the risk of wearing out your patience, it is my purpose to repeat some things which have been told you at these annual meetings for the past seventeen years, or since the time when the state legislature, at the behest of the growers of the state, enacted the law creating the State Plant Board. I do not propose, however, to go into any great detail as to the organization of the Plant Board work and how that work is done by the several departments operating under the Plant Commissioner's direction, although some reference, in a more or less general way, will be made to this.

It will be recalled that the Plant Act was passed at a time when the citrus industry was thought to be, and really was, threatened with disaster through the presence in our groves of a new and malignant disease which came to be known as citrus canker. To combat this condition required concerted action upon the part of State and Federal governments and the industry. There was a condition which verged upon panic. A campaign of eradication was planned and carried forward which not only was successful but which made horticultural history and constituted a precedent of accomplishment which has served as a basis for similar projects in crop pest control and eradication which have since been carried forward. To those who participated in this campaign and to those who had intimate knowledge of the conditions then existing the campaign and the results stand out as a record of efficiency and accomplishment. The same may be said of the more recent danger to which the state's horticulture was exposed and from which it was rescued. I refer to the Mediterranean fruit fly. No individual in any way connected or associated with that activity need be ashamed of the connection. On the contrary, it is a source of pride. In this instance we again have a record of accomplishment. I am not going to attempt to combat the views of those relatively few individuals who hold opinions which differ from mine as to the necessity for the fruit fly eradication campaign, the manner in which it was conducted or the methods used. The cold, hard facts are: (1) The Mediterranean fruit fly was here in our groves in large numbers; (2) The Mediterranean fruit fly is a major pest; (3) the eradication effort has apparently been successful. There is no evidence to the contrary. Those facts are inescapable. There is one other fact, namely: Had there been no state regulatory body charged with the duty imposed upon the Plant Board, the job could not and would not have been done, no matter how much money the Federal government might have made available for the purpose, and no matter how insistent the industry might have been that the attempt be made.

Plant quarantine is primarily for the protection of agriculture against plant pests. Plant quarantine is a weapon which must be used with discretion and judgment. There must first be justification. There must next be ability, fairness and firmness in administration. There are plant pests which should be prevented entry and dissemination. This can only be done through the

agency of plant quarantine. The means may be either by embargo or by restriction and regulation. The former is justified only in the case of major pests. The latter is the more frequent and usual method. The Plant Board is attempting to accomplish its objective through three main agencies: Nursery inspection, grove inspection, port and gateway inspection. No nursery stock may enter the state or be moved within the state unless and until it has been properly inspected, found to be safe, and so certified. No horticultural material from foreign countries may enter unless it is in compliance with the requirements of the quarantine regulations of both Federal and State Governments and passes the searching scrutiny of our inspectors at ports of entry. Supplementing these two services and as an added safeguard, there is maintained a grove inspection service. The plantings of the state are under patrol to discover the presence of any major pest which may, in spite of our efforts, have secured a foothold. These are the three main agencies made use of by the Board for your protection. The limitation on efficiency is that of resources. It is our feeling that Florida's protective work is being well handled. We have no false modesty in this respect. We think that we are doing a very good job, but we also think that there could be improvement and strengthening. With our present personnel we are inspecting commercial nurseries in the state an average of four times a year. In the southern area the nurseries receive inspection at even more frequent intervals. In the more northern areas, where climatic conditions are quite different, but three inspections per annum is the rule. At the ports of entry every ship from a foreign port is boarded and inspected by our men. Every airplane is likewise handled. With our present grove inspection force we are able to make inspection of our grove plantings at the rate of one coverage every two years. None of these activities can be curtailed without a proportionate weakening of protection. Just a very few figures to show the scope of our work:

In the state there are 1,846 nurseries and 219 narcissus plantings under inspection and certification.

During 1931 4,138 boats and planes from foreign ports arrived at Florida ports and were inspected. This is somewhat less than during normal times.

There are 24,323,850 citrus trees in the state inspected biennially.

Truck and highway patrol problem — a wide open gap in our defenses. Under present conditions hopeless to expect to close the gap tight through state line highway inspection stations. Alternative and helpful procedure would be notices at crossings and a motorcycle patrol.

Announcement

An informal reception will be given by the University in the State Museum, at 5:30 Thursday afternoon, immediately after the trip to the campus and Experiment Stations. All are invited.

ECONOMIC FACTORS OF IMPORTANCE IN THE CITRUS INDUSTRY WITH PARTICULAR REFERENCE TO COST OF PRODUCTION

C. V. Noble, Agricultural Economist, Experiment Station
University of Florida, Gainesville

In order to bring the citrus fruit situation clearly before us, the following quotation is taken from the 1932 Agricultural Outlook Report of the U. S. Bureau of Agricultural Economics:

"The combined production of oranges and grapefruit has increased tenfold during the last forty years and has been increasing at an average rate of about six per cent per year during the last ten years. By the fall of 1931 the total number of trees in orange and grapefruit groves was twice as large as it was in 1920."

The Federal Outlook Report also states that citrus production in foreign countries is rapidly increasing and that it will become increasingly difficult for this country to enlarge its citrus export trade. The recent tariffs on citrus fruits imposed by countries containing our leading export markets create a still greater sales resistance.

Statistics compiled by the Grove Inspection Department of the Florida State Plant Board show that the number of citrus trees in Florida groves increased from 11,356,414 in 1919 to 24,323,850 in 1931, or approximately 114 per cent. This indicates that the Florida plantings have increased more rapidly than for the country as a whole.

In the face of this situation in the citrus industry, there appears to be no reason for changing the conclusion presented to this body two years ago that "Additional plantings of either oranges or grapefruit in Florida in the near future do not appear wise unless it is known that there is a shortage of specific varieties which are not already included in our non-bearing acreage."

With the prospects of a rapidly increasing volume of citrus fruit and the probability that consumer demand will not increase proportionately, the real hope of the future prosperity of the Florida citrus business seems to rest upon methods of decreasing the costs. These costs may be roughly divided into three phases:

1. The costs of producing fruit.
2. The costs of picking, hauling and packing the fruit; that is, from tree to car.
3. The costs from packinghouse to purchaser; principally transportation costs.

These cost phases will be taken up in reverse order.

The costs of transportation to market are costs over which the individual grower has little control. It is only through the combined efforts of growers and shippers of citrus fruits that headway can be made in decreasing these costs. Much has already been accomplished by our Growers and Shippers League and its future accomplishments will depend upon the full co-operation of every grower and shipper in this state. In a study of transportation rates* it was found that there was a lack of uniformity of rates from different sections of the country and that Florida growers were being unduly penalized. The present temporary reduction in the Florida citrus rates will go far toward bringing its rates into equilibrium with competing citrus producing areas. It is the hope that the present reductions may be made permanent.

The costs of picking, hauling and packing fruit, commonly thought of as packinghouse costs, are much more nearly under grower control than the transportation costs. Even here, however, it will be difficult to make headway in reducing costs without the full co-operation of growers. In a study of this phase of citrus costs† it was found that there was a range of over 100 per

*Brooker, Marvin A. A Study of the Cost of Transportation of Florida Citrus Fruits with Comparative Costs from Other Producing Areas. Fla. Agr. Exp. Sta. Bul. 217:1930.

†Hamilton, H. G. Cost of Handling Citrus Fruit From the Tree to the Car in Florida. Fla. Agr. Exp. Sta. Bul. 202:1929.

cent in the cost per box between the lowest and the highest cost packinghouse, and that the principal factor affecting this cost was the volume of fruit handled per dollar of investment in packinghouse facilities.

In a study now in progress* it was found that citrus co-operative associations were handling the following percentages of the total volume of fruit being shipped from the shipping points where the co-operative packing plants were located:

Season	Number of co-operative associations	Per cent of total volume handled at stations where associations were located
1926-27	61	47.9
1927-28	67	47.5
1928-29	68	52.5
1929-30	70	54.2
Average		50.8

It will be noted that these associations were handling about one-half of the fruit that was shipped from these points. Many of these associations could handle the total volume of fruit at their shipping point by full-time work or by employing two or three shifts at the peak of the crop movement, without increasing their packing facilities. Others would be warranted in increasing the size of their packing plants if the proper volume of fruit could be secured. There are many indications of a surplus of citrus packing plants in this state for the efficient packing of the present volume, or the expected increase in volume of citrus fruit during the period of use of these plants.

The phase of citrus costs over which the individual grower has the greatest control is the cost of production phase. In order to intelligently plan methods for reducing production costs, however, it is essential that the grower have detailed cost records of past experience with his grove. It is also desirable that he have access to similar cost results from other groves with which to compare his items of cost. It was with this idea in view that the Extension Division of the College of Agriculture started co-operative cost of production studies with a number of grove owners in Florida in the fall of 1930. A summary of the results for seventy-six groves in Orange and Lake Counties for the 1930-31 season follows (Table 1):*

TABLE I

COSTS OF PRODUCTION AND RETURNS FROM CITRUS FRUIT IN 76 LAKE AND ORANGE COUNTY GROVES 1930-1931

Value of groves per acre $944
Yield in boxes per acre 171

Item of cost	Per acre	Per box	Per cent of total
Labor, power and equipment	$ 26.73	$.156	18.5
Fertilizer	36.85	.215	25.5
Spray materials	2.18	.013	1.5
Taxes	10.49	.061	7.2
Interest at 7% of value	66.08	.386	45.6
Miscellaneous	2.44	.014	1.7
Total cost (except operator's supervision)	$144.77	$.845	100.0
Total returns for fruit	$135.03	$.788	
Net returns (operator's supervision and profit)	$ 9.74	$.057	

It is here shown that the average cost of production per box of citrus in these seventy-six groves was 84½ cents, or 5.7 cents per box more than they received for their fruit. This does not mean that there was an out-of-pocket loss on these groves, but it does mean that they were not paying the current rate of interest on their investment. If the interest charge were omitted from the items of cost, the net return would be equivalent to approximately six per cent on the investment.

*Hamilton, H. G., and Brooker, Marvin A. A Study of Co-operative Associations in Florida.

*Brumley, F. W. and Briggs, W. R. Costs and Returns for Citrus in Orange and Lake Counties, 1930-31. Fla. Agr. Ext. Economist, Vol. 1, No. 10, October, 1931.

There was a very wide variation in the costs and returns among these seventy-six groves. The yield of fruit per acre per grove varied from twenty-two to 497 boxes. In order to bring out the effect of yield per acre on costs and net returns, the ten groves with the highest yields were compared with the ten low yield groves (Table II).

high yield group were grapefruit, while only 5.5 per cent of the trees in the low yield group were grapefruit. The records were not kept in sufficient detail to separate the costs by age and kind of trees. Other desirable separations of costs would be by variety of fruit, type of soil and kind of root stock. It is also essential to record quantitative data, such as *hours* of labor,

TABLE II

RELATION OF YIELD PER ACRE TO COSTS AND RETURNS IN 76 LAKE AND ORANGE COUNTY GROVES 1930-1931

	10 highest yield groves		10 lowest yield groves	
Value of groves per acre	$1084		$762	
Yield in boxes per acre	382		40	
Item of cost	per acre	per box	per acre	per box
Labor, power and equipment	$ 59.54	$.156	$ 18.46	$ .460
Fertilizer	59.02	.155	24.68	.616
Spray materials	3.46	.009	1.40	.035
Taxes	14.33	.037	7.19	.179
Interest at seven per cent of value	75.88	.199	53.33	1.350
Miscellaneous	4.36	.011	1.21	.030
Total cost (except operator's supervision)	$216.59	$.567	$106.27	$2.650
Total returns for fruit	$299.20	$.784	$ 32.91	$ .821
Net returns (operator's supervision and profit)	$ 82.61	$.217	-$ 73.36	-$1.829

Although the ten high yield groves had a total acre cost approximately double the similar figure for the ten low yield groves, the cost per box was about four and one-half times greater in the low yield than in the high yield groves. On the other hand, the returns per box were slightly higher for the low yield groves.

The first question that arises, as the effect of yield on net returns is examined, is the cause of these great differences in yield. There are two very obvious reasons when the individual groves are examined. In the first place, only 25.7 per cent of the trees in the high yield group were under seventeen years of age, compared with 94.6 per cent of the trees in the low yield group. In the second place, 26.6 per cent of the trees in the

pounds of fertilizer, etc. These quantitative data are of more value than the dollar figures for making comparisons over a period of years, especially during periods of rapid price changes. *Kinds* of fertilizers and other materials used should also be recorded.

Although the cost of production phase is the one over which the grower has the greatest control, it has probably been given the least attention and study. The Economics Departments of the College of Agriculture are preparing to put more emphasis on this type of work, but will be helpless without the full co-operation of interested growers. It is the hope that real progress in this line of work may be reported to this body from year to year.

TRAFFIC MATTERS OF IMPORTANCE TO THE CITRUS INDUSTRY

J. Curtis Robinson, Growers' and Shippers' League, Orlando

Reasonable rates for transportation and refrigeration, together with fast dependable schedules are fundamental to the continued success and prosperity of the Florida citrus industry. Anything that affects the cost for transportation, or refrigeration or that tends to increase or retard the distribution of Florida citrus might properly be termed a traffic matter of importance to the citrus industry.

There are incidental services performed by shippers which contribute materially to prolonging the life of fruit and to insuring its safe delivery in the markets which might also come under the head of traffic matters of importance to the citrus industry, I refer to pre-cooling of citrus by shippers.

I remember about two or three years ago when I spoke to your association, I announced that the Florida initial carriers had finally concluded they could reduce their schedule from fifth morning to fourth morning to New York. This was done by the railroads after several conferences with them and they first felt that the schedule could not be reduced. They have not only reduced the schedule from fifth to fourth morning to New York, Chicago and other northern markets, but they have maintained the reduced schedule with remarkable regularity. This is a traffic or transportation matter of importance to the citrus industry which resulted largely from persistent agitation by the Growers and Shippers League.

The cost for refrigeration or other protective service is a question of great importance to growers and shippers.

In 1929 the Interstate Commerce Commission authorized a reduction of around $10.50 per car in the standard refrigeration rates on citrus and vegetables to eastern markets east of the Buffalo-Pittsburg territory. The carriers sought to advance these rates but after several hearings and vigorous opposition by the League and State Railroad Commission, a reduction was secured which resulted in a saving in excess of $500,000.00 annually.

When the investigation of refrigeration rates to eastern destinations was completed the Interstate Commerce Commission set up a formula for arriving at a reasonable refrigeration rate. This formula provided for an allocation of certain specific amounts for cost of ice, haulage of ice in ice bunkers and the several other factors incident to refrigeration service. The Commission concluded that they would only order specific reduced refrigeration rates published to eastern territory. They said, however, as to destinations north of the Ohio, east of the Mississippi to and including the Buffalo-Pittsburg territory, that it would not be difficult for the railroads to adjust their refrigeration charges to that territory in line with the findings or formula that had been specified by the Commission in arriving at proper rates to eastern territory. The Commission said "and this should be done," meaning that the railroads should reduce our refrigeration rates to that territory lying north of the Ohio and east of the Mississippi to and including Buffalo-Pittsburg territory. The carriers made no reductions and the League now has pending before the Commission a complaint seeking reduction in the refrigeration rates to this central territory similar to that made to eastern territory.

Several years ago the League joined with several other associations, including some of National scope, in an appeal to the Interstate Commerce Commission for an investigation of all the refrigeration rates in the United States. As a result of our appeal the Commission undertook such an investigation, the first of which was from Florida to eastern destinations. The second investigation involves not only refrigeration rates between California and other Pacific Coast states and the east, but includes refrigeration rates between Florida and the Pacific Coast. The hearing in this case, Docket 20769, began at San

Francisco, April 4th. The League, representing the growers and shippers of this state, was represented at that hearing by its counsel. That hearing was of particular importance to the growers and shippers of this state because the question involving the cost of ice supplied bunkers of refrigerator cars at all points in the United States was to be considered. Cost of ice and haulage of ice in ice bunkers constitute about seventy-eight per cent of the total refrigeration charge.

If the carriers, as a result of the hearing in the San Francisco case, should succeed in convincing the Commission that the cost of ice and haulage of ice should be more than that allowed by the Commission in our Eastern Refrigeration Case, then it might be we would get no reductions to northern or western markets and might ultimately have our refrigeration rates increased to eastern markets. Therefore, we participated in this hearing at considerable expense to safeguard as far as possible our growers' interests in the ultimate cost for refrigeration to all markets.

Many of our associations and shippers have themselves provided pre-coolers to cool the fruit promptly after packing and enable its shipment under initial icing, only, at a saving in refrigeration of around $20.00 to $25.00 per car. Some shippers who were able to purchase their ice for initial icing of cars from local ice manufacturers at origin points, were able to save much more than these amounts. Recently the carriers, apparently in an effort to force shippers to buy ice from their refrigeration agent, the Fruit Growers Express Company, adopted rules refusing longer to permit shippers to switch cars to ice plants for icing and then place them at packing houses for loading.

The League filed protest with the Commission against these rules but they were permitted to go into effect. This action on the part of the initial Florida lines forcing shippers to purchase ice from the Fruit Growers Express Company at a cost in excess of what it can be bought for from local companies, is an unwarranted policy that has already resulted in probably more loss of business to the railroads than will be gained in increased revenues as a result of forcing shippers to use their ice.

Another service Florida needs is the privilege to ship fruit with initial icing and one re-icing in transit. We have had considerable correspondence and one conference recently with railroad and refrigeration company officials, looking toward the establishment of this service. At present, carriers are willing to establish the service, but want to charge rates that are only about $7.50 per car lower than for full refrigeration where cars are iced at all re-icing points in route. We hope to get this service established on rates that are reasonable for the service performed.

The airplane has not yet become a factor in commercial transportation of citrus fruit. We must continue to rely on railroads and steamships chiefly, although lately, with the continued improvement of our roads, the motor truck has become an important factor.

TRUCK MOVEMENT

There will be those who are favorable to and those who are vigorously opposed to transportation by truck. I will not argue the point here but merely say in passing, that in my opinion, truck transportation for reasonable distances is here to stay. Whether growers themselves use it, or do not use it, there is no question in my mind but what the service will continue from now on to be a factor in the transportation of citrus fruit.

The railroads have finally recognized its effect upon their revenues by the quantity moved by truck to southern markets. Recently they reduced the rail rates to many southern markets by twenty-five per cent but at the same time increased the minimum carload from 360 boxes to 384 boxes. I do not think this will have the desired effect of overcoming truck competition. Trucks haul less than the old 360 box railroad minimum and unless the quantity hauled by the average truck can be equalized by rail at a comparable rate, citrus fruit will continue to move to southern markets in large volume by truck.

There are undoubtedly many markets in the south that are not equipped to hold as much as a carload of citrus but can quickly consume as much as would be hauled on a truck. Unless the minimums by rail can be made equal to what would be the maximum number of boxes hauled by truck distributors in small markets will continue to get fruit by truck either from Florida or from the large markets. At any rate the high rail minimums to southern markets will, in my opinion, not serve to increase distribution to those markets, especially by rail.

I am convinced there is a better solution for retaining more business to the rail lines than increasing the old minimum by twenty-four boxes and only reducing the rate by twenty-five per cent. I would advocate further reduction in minimum and rates and the use of ventilated box cars for these short hauls to southern markets. This would have to be supplemented by an arrangement for consolidating the small loads in transit at some concentrating points in the south for shipment of a reasonable minimum carload to northern markets in the event that the small carloads were not ultimately marketed in the south.

WATER MOVEMENT

The movement of citrus by water, which in the last few years had dwindled to about five per cent of the total, revived again this season and withdrew from all-rail movement increasing quantities of citrus traffic. This proved such a threat to the diminished rail revenues, that in February the railroads agreed to a reduction of eighteen per cent in their rates to New York and applied that rate to eastern seaboard ports south of New York in an effort to retain to the all-rail haul the majority of the citrus traffic. The steamships immediately followed the rail lines by a material reduction in steamship rates. With the reduction of the citrus rates to eastern port markets, the railroads increased the minimum eighty-four boxes or to 444 instead of 360 boxes. This makes a larger unit of sale, increased the risk of decay, and makes inspection at destination more difficult, if not impossible. However, it affords reduction in the transportation cost per box of an amount approximately seventeen cents per box, on the average, to New York with lesser amounts of reductions to the nearer markets, which is worth saving if it can be done without undue risk of deterioration in transit.

BLANKET RATES AND INCREASED DISTRIBUTION

A blanket rate is a rate that covers the country like a blanket covers a bed. California has blanket rates on citrus because the same rate of $1.55 per 100 pounds applies from all California origins for citrus to all points in the United States from Denver east. The railroads recently by reducing the New York rate by eighteen per cent and applying that rate as maximum to all points intermediate between Richmond, Va., and New York are making their own experiment in the application of a temporary blanket rate to a restricted number of destinations. This does not mean that this blanket rate to New York and points south as far as Richmond, is the same from all Florida origins because there is a lower rate from Crescent City than from Orlando, and a lower rate from Orlando than from Lake Wales and so on. The further the origin is located south of Jacksonville the greater is the charge to New York.

It is my opinion that one of the biggest problems yet to be solved by Florida is to work out with our initial Florida railroads and through them with their northern connections a basis of blanket rates to the markets on citrus fruit that will give us a more reasonable rate to all markets and will, in my judgment, materially increase our Florida distribution.

While our rates per 100 pounds and per box are at present from the majority of origins to the destinations to which the majority of our traffic is distributed, lower than from California, they still have a big advantage over Florida in the distribution of their citrus. That advantage lies in the fact that California can move its cars from market to market east of Denver without one cent of additional freight cost, while every time Florida moves a car from one market like Cincinnati to Indianapolis or from Indian-

apolis to Chicago there is an addition or increase in the rate to the further market over the nearer market.

It does seem to me it would be of tremendous advantage in the marketing of Florida citrus if we had a blanket rate applying from Florida to all important markets. Perhaps the railroads would not be averse to granting a blanket rate, if we could agree upon the proper rate to be appplied. We would of course not be in favor of taking the New York or Chicago rates and applying them back as far as Savannah and Atlanta. To do so would tend to drive the citrus traffic entirely to the trucks for short hauls and to the water lines for distribution to the northern markets. Neither would we expect to take the present rates to Atlanta and Savannah and stretch them out to apply to Chicago and New York. I do believe there is a middle ground which if adopted might prove to be of material advantage to the growers and shippers in the distribution of Florida citrus and equally important to rail carriers by retaining to rail lines much of the traffic which has strayed far afield and is moving to the markets by other means of transportation. The rail lines have the tracks, motive power, and an abundance of equipment. Rather than have it rust out in uselessness it should be put to work. If we can get together on rates that are mutually satisfactory, much if not all of the traffic now lost to the rail haul should be returned to them.

REDUCED RATES FOR EXPORT GRAPEFRUIT EXPECTED

Recently the League appealed to the Coast Line and Seaboard for reduced rates on grapefruit to eastern seaboard ports for export to foreign markets. Some preliminary conferences had been held between some of the shippers and Florida and Eastern railroad lines traffic officials. We have been advised within the last few days by high officials of the Seaboard and Coast Line that they have secured the agreement of the Eastern lines for the publication of rates to Eastern seaboard markets on grapefruit for export which will be five cents per 100 pounds less than the rates to New York reduced by eighteen per cent in February. The new rates will carry a minimum of 458 boxes. All that is necessary now is for the Interstate Commerce Commission to grant permission to publish these reduced rates immediately instead of waiting the usual thirty days.

Ladies and gentlemen, I have tried to outline some of the traffic matters of interest to the citrus industry. There are two which I overlooked commenting upon. One is a complaint recently filed by the League against the rates on citrus to Eastern markets. This involved a failure on the part of the railroads to publish rates on citrus in specific conformity with the order of the Interstate Commerce Commission in our Line Haul Rate Case.

We expect to have these rates adjusted to the exact basis prescribed by the Commission which should make reductions of from one cent to several cents per 100 pounds to eastern destinations. We have asked for reparation which if awarded should enable our shippers to collect refunds on shipments made within the past two years.

The other case to which I refer is a complaint against our refrigeration rates to destinations north of the Ohio River and east of the Mississippi River on which we have also asked for reparation for overcharges within the last two years.

While my subject deals with traffic matters of importance to the citrus industry, I call your attention also to the fact that the vegetable industry, which is closely allied with the citrus industry, has its traffic problems also. The League since its organization has been able to iron out a great many of the vegetable traffic problems and has saved for the vegetable growers and shippers hundreds of thousands of dollars, annually.

The rates on Florida vegetables are still on a higher level than the rates from competing southwestern and other territories. We have recently filed a complaint on our vegetable rates which will be heard at Atlanta, Georgia, May 13th. We hope to be able to get our vegetable rates adjusted to a more equitable basis.

It should be of interest to you to know that due to the work of the League, the rates on citrus since 1928 have been approximately $1,000,000.00 less, annually, than they were prior to that date.

That a saving of approximately $500,000.00 annually, was made in the refrigeration rates since June, 1929.

That approximately $80,000.00 will be saved, annually, in preventing increase in charges for the use of refrigerator cars for pre-cooled citrus and for top icing of vegetables.

That a saving of approximately $80,000.00 annually, was affected by preventing an increase in the standard refrigeration charges to eastern territory.

That approximately $40,000.00, annually, was saved by securing a reduction in the citrus rates to territory intermediate between the Missouri River and the west.

That due to the efforts of the League, State Railroad Commission, and others, something over approximately $2,000,000.00 was saved the industry in transportation and refrigeration costs by preventing the imposition of the full fifteen per cent increase asked by the railroads this past summer. If the full penalty had been applied for the two-year period, it would have imposed an additional burden on the Florida citrus and vegetable industries in excess of $4,000,000.00.

In conclusion may I not appeal for an increasing interest in traffic matters affecting the citrus industry. After all, distribution, and the net rate of return to you on your investment in the citrus industry lies primarily in the rate you have to pay for freight and refrigeration and the service you get in return for the rate you pay. Consciously or unconsciously you are all vitally interested in traffic matters that affect the citrus industry.

I received a wire yesterday that reduced the rates for export on grapefruit that would go into effect April 27th.

There is one other matter. Yesterday I learned that there was a strike on the dock of the Clyde-Mallory Steamship Line at New York. There were 118 cars of citrus fruit tied up on the docks, and the strikers refused to permit the consignees to unload it, or take it away from the docks. I got in touch immediately with our counsel in Washington, and he is in New York today trying to adjust the matter, and take it up with the governor or mayor in an effort to get that fruit unloaded. I understand that yesterday some receiver in New York got a truck, loaded a few boxes on it which belonged to him and he had a right to take, and the strikers said, "Here, Buddy, that's enough." So that's a traffic matter of importance for the citrus industry that we are trying to handle today.

VITAMINS — WHAT THEY ARE AND WHAT THEY DO

Dr. Ouida Davis Abbott, Experiment Station, Gainesville

The term vitamin has been defined as a group name for substances other than fats, carbohydrates, proteins, and minerals, which are found in minute quantities in natural foods. They are essential for normal nutrition and for the prevention and cure of various pathological conditions known collectively as deficiency diseases. Up to the present time that is about all that could be said of vitamins with any degree of certainty. The chemical structure was unknown and no one had seen a vitamin. But to reject vitamins because their chemical structure was unknown would be illogical, for the chemical structures of toxins, antitoxins, enzymes, and insulin are still unknown, yet we know all of these substances as powerful realities. As with these other substances the therapeutic and practical importance of vitamins has outrun the investigation of their chemical nature. Almost no group of substances can out-rival vitamins in the extent of the information which has accumulated since their postulation about twenty

years ago. The realization that a diet may be adequate in energy and protein and still be inadequate in both organic and inorganic constituents opened up a new field of research. The idea of vitamins took hold of the imagination of the people and nearly every laboratory began the feeding of rats and guinea pigs. Unfortunately vitamins were discovered at a time when conservation and substitution of food was made imperative on account of the war. Hence vitamins became commercialized before the careful basic work had been completed. They became known as the mysterious vitamins, when in reality there is nothing any more mysterious about the action of vitamins than there is about iron or iodine or any one of the elements or compounds essential for life.

At the present time there are six independent vitamins, whose existence has been definitely proved, and the data are indicating the possibility and probability of at least three more. The known vitamins are vitamins A, B, C, D, E, F and G.

Vitamin A.—Vitamin A was one of the first vitamins discovered. It is essential for growth and well being of all ages. While it is not the anti-sterility vitamin, it is necessary for reproduction. The absence of this vitamin from the diet produces in experimental animals very definite changes, the most conspicuous of which is condition of the eye known as xerophthalmia, but the most frequent is the abscess at the base of the tongue, and the pus in the sinuses and ears. When vitamin A is low in the diet over a long period there is an increased susceptibility to bacterial infection, which is supposed to be due to the weakened condition of the tissues. It has been found that the body has the power to store this vitamin and is able to draw on this supply for future needs. An abundant supply of vitamini A in early life seems to safeguard the body against later infections as well as providing protection for the present. As growth proceeds the amount of this vitamin must be increased. During pregnancy and lactation there must be a still further increase in the vitamin content of the diet if it is to meet the added demands of these functions.

The chief sources of vitamin A are eggs, liver, milk and butter, thin leafed green vegetables and the pigmented ones. It has been very definitely proved that carotin is the organic compound present in plants which forms vitamin A in the body. Carotin is a constituent of chlorophyll, and this is the green pigment in plants. In finding that carotin is the constituent in plants that is essential for life, again there is emphasized the wisdom and providence of nature in distributing this compound so widely and abundantly. Chlorophyll is made up of four pigments, two green pigments and two yellow ones. The green pigments are called chlorophyll alpha and beta, and the two yellows are called carotin and xanthophyll. We have been able to show that of these four pigments carotin is the only one that can supply the material from which the animal body can make vitamin A. Tomatoes are an excellent source of vitamin A, but again the precursor is carotin and not the red pigment lycopersicin which covers the carotin. It is evident then that all yellow and green vegetables are richer in the precursor of vitamin A than the white ones, hence yellow sweet potatoes and yellow corn would have more value in the diet than white sweet potatoes and white corn. If all the yellow color in satsumas and tangerines is due to carotin then they should be more potent as a source of vitamin A than oranges. It also explains why grapefruit juice and lemon juice are lacking in this factor and why the oils of citrus fruits contain the precursor of vitamin A.

While it is generally accepted that carotin is the parent substance from which vitamin A is synthesized by the animal body, the exact chemical nature of vitamin A is still in the experimental stage. Some investigators are of the opinion that there is an exzyme in the liver that splits carotin into vitamin A and that a new substance is formed that is much more potent than carotin. By some it is claimed that vitamin A is one of the higher alcohols, and still others believe that vitamin A is closely kin to synthetic violet perfume, the basic material of which is ionome. This substance is closely related to the terpenes, which occur in resins and turpentines. It is evident that the exact nature of vitamin A

is still unknown, but as long as we know that carotin is the substance from which it is made it is unnecessary that any one should have a diet low in this substance.

Vitamin B.—This vitamin was also one of the first vitamins postulated, and is now known as the vitamin B complex since it contains at least two separate and distinct vitamins which are now know as vitamin F and G.

Vitamin F.—Vitamin F is known as the anti-neuritic vitamin. It is soluble in water and is relatively heat stable. This vitamin has been found to prevent polyneuritis in pigeons and chickens, a similar disease in rats, and probably beri beri in man. The symptoms of this deficiency are loss of appetite, a rapid loss of weight, a nervous condition which is characterized by spasms and paralytic seizures. When vitamin F is added in even minute quantities the recovery is almost miraculous, and this may account for calling the vitamins mysterious.

Vitamin F is stored in the body to a very limited extent. As with vitamin A, this vitamin must be increased during lactation for it seems to be of special importance to lactating animals. The most abundant source of this vitamin at the present time is a water extract prepared from corn and wheat germ. However, except in times of limited food or where the diet is made up of highly purified food materials there is little danger of a deficiency in this factor. Nearly all the grains have it in large amounts, most vegetables are excellent sources, while fruits are upon the whole rather a poor source of the vitamin. It has been found, however, that grapefruit, oranges, and lemons are well supplied with this vitamin.

The other member of the vitamin B complex, vitamin G, is often called the anti-pellagra vitamin. When this vitamin is absent from the diet of experimental animals there is a retardation of growth, soreness of the eyes, nose, and mouth, and a loss of hair. In the absence of vitamin F the animals become nervous and irritable, but in the absence of vitamin G they become weak and lethargic. While there are some very striking resemblances to pellagra there are not enough to make the acceptance of vitamin F deficiency as a cause of all types of pellagra.

As stated above it has been found that cereals appear to be an excellent source of vitamin F, but are relatively poor in G. Skimmed milk is high in this factor so cereals and milk make a combination which gives both F and G in liberal amounts. Bananas have been found to be high in G but deficient in F. Tomatoes, fish, lean beef, have all been found to contain vitamin F so that they may be classed as protective foods. Turnip greens have been found to be an excellent source of vitamin G, so that the South has a very cheap source for this vitamin.

The chemical nature of the vitamin B complex is not known. This is probably due to the fact that during the greater part of the experimental work the complex nature of vitamin B was not recognized, so that the isolation and identification of vitamin F and G was necessarily delayed.

Vitamin C.—Long before there was a vitamin theory the value of citrus fruits as a cure and preventive of scurvy was well recognized. When fresh fruits and vegetables are absent from the diet of man or guinea pigs, scurvy develops. This disease is characterized by soreness of the joints, with a tendency to hemorrhage, soreness of the gums, with a loosening of the teeth and a fragility of the bones. Formerly this disease was somewhat prevalent among babies and among adults in times of long sea voyages and of famines. On diets low in this vitamin children become irritable and show less resistance to infectious diseases. A shortage of vitamin C is thought to be an important factor in the prevalence of tooth decay and much of the so-called rheumatism of children. Vitamin C, like all other vitamins, is widely distributed in natural food materials. It is present in varying amounts in most fruits and vegetables. Citrus fruits apparently lead the list in the abundance of vitamin C, which they contain. Raw cabbage, turnips, rutabagas, and tomatoes are excellent sources of this factor. Cereals and legumes contain no appreciable amount of vitamin C but if they are allowed to sprout they become a fairly rich source of the vitamin.

When foods containing vitamin C are cooked or the juice of fruits extracted the retention of vitamin C becomes a problem. It is easily destroyed by heat and by oxidation. In the open kettle method of canning vitamin C is easily destroyed in most foods, while in the commercial or cold pack method of canning there is a retention of the greater part of the vitamin. It has been found that when orange juice was neutralized and allowed to stand for twenty-four hours the antiscorbutic properties were lost. Hess has shown that orange juice has lost some of its potency after storage in a refrigerator for three months. There is a difference of opinion as to the value of dried orange juice as an antiscorbutic, some investigators found that there was a gradual destruction of the vitamin of dried orange juice stored at room temperature which amounted to about fifty per cent in fiften months, while others report that dried orange juice retained the antiscorbutic properties after three months' storage. Experiments on the preservation of oranges and lemons in cold storage were not particularly satisfactory on account of the fact that the fruit did not keep well for any length of time, but the results indicate that whenever the fruit was edible the antiscorbutic propertly was not seriously damaged. Oranges and lemons stored in a frozen condition for five years retained about half of their antiscorbutic value. Orange and lemon juices preserved in the rind oil retained their activity after storage from one to three years. Work done at the California Agricultural Experiment Station on orange juice concentrates shows that the concentrated whole juice retained practically all the antiscorbutic value of the original juice. The desiccated juice, at the end of two years still retained a good proportion of its antiscorbutic properties, and the dried whole juice proved to be a highly concentrated source of vitamin C.

The vitamin content of frozen citrus juices is still uncertain. In Miss Smith's new bulletin from the U. S. Department of Agriculture, she shows that the vitamin A and B content of orange juice frozen and stored is uncertain and that the vitamin C content has been reduced about one-third. Since the methods used in freezing and storing are not given, before a definite statement could be made it would be necessary to test samples from known methods for it is possible and probable that the amount of vitamin C might be greatly influenced by the method used.

Orange peel has been found to contain vitamin C but the peels of grapefruit and lemon do not possess this factor in appreciable amounts.

Taking orange juice as a standard, peaches and apples are about one-half and pears about one-fourth as potent as oranges. Papayas, pineapples and mangoes are good sources of vitamin C. Some investigators report that mangoes have been known to cure advanced cases of scurvy where all other means failed.

As to the chemical nature of vitamin C investigators are still uncertain. Phosphorus, iron and sulphur have been found in the active concentrates. It has been very definitely proved that vitamin C is not citric acid, nor the ash. One very potent extract has been prepared which has yielded on evaporation, needle-like crystals which were very hygroscopic and easily oxidized. Upon oxidation a yellowish brown quinone was formed. The minimum protective dose for guinea pigs was less than two milligrams daily. Some Norwegian investigators claim to have isolated a substance from narcotine which is an opium derivative that relieved scurvy and they were of the opinion that this was vitamin C.

Vitamin D.—Because Vitamin D is fat soluble and present in codliver oil, very early in its history it was confused with vitamin A. Later work showed that there were two fat soluble vitamins which were quite distinct in their action. Vitamin D is called the antirachitic vitamin because it has the property of promoting the assimilation of Ca and P and thus controlling bone formation. Further investigations showed that exposure to ultra violet light had the same beneficial effects as codliver oil and that exposure of other food materials to this light conferred on them antirachitic properties. This is due to the presence of ergosterol, which become a powerful antirachitic agent upon irradiation. Ergosterol is present in minute traces on the skin and it is believed that the favorable effect of ultra violet light is due to the formation of vitamin D from

the ergosterol in the skin. Irradiated ergosterol is now on the market, under the trade name of viosterol. Its use is recommended for the prevention and cure of rickets. However, codliver oil is better in most cases of rickets, as ergosterol, while a most potent calcifying agent, does not stimulate growth as codliver oil.

In addition to the curative and preventative effects of vitamin D in rickets it has been found to have other very effective uses in medicine. It has been found to hasten blood clotting by increasing the number of thrombocytes. Its use will be indicated in cases of bleeders and in jaundice. Irradiated ergosterol has been found beneficial in the treatment of radium poisoning.

The exact chemical structure of vitamin D is not known. British investigators have prepared the most active antirachitic substance known, it consists of colorless crystals formed by the irradiation of ergosterol. The elements are in the same proportions as in ergosterol although the structure may be different. American investigators treated ergosterol with nitrogen monoxide and obtained crystals which are very potent. This is the first time an antirachitic substance has been formed without the use of ultra violet light. Whether these two compounds are identical is not yet known.

Among natural food sources liver and egg yolk are probably the richest sources of this vitamin. Milk and dairy products contain it in small but appreciable quantities. Almost any food can be irradiated and made antirachitic, but codliver oil is one of the best natural sources of this factor.

Vitamin E.—This is the reproductive vitamin or antisterililty vitamin. In its physical properties it resembles vitamins A and D but differs from them in its distribution. It is practically absent from codliver oil but is present in vegetable oils. The oil of wheat embryo is one of the richest sources while the best natural food is lettuce. It is present but never highly concentrated in a great variety of animal tissues and fat. Milk and butter fat contain it in small amounts.

In conclusion it should be emphasized that there is no need to worry about vitamins. A well balanced diet of natural foods contains enough of the known and also the unknown vitamins to furnish all the factors needed. When concentrated vitamin preparations are needed they are too potent to be prescribed and administered by the laity, but must be given by a physician.

A RESUME OF THE HORTICULTURAL CROPS OF NORTHWEST FLORIDA AND THEIR CULTURE

C. A. Simpson, Monticello

For the purpose of this discussion, northwest Florida is assumed to consist of that part of Florida lying west of the Aucilla River. The larger part of this area of Florida has a rolling contour and many high hills, which make it an idieal horticultural section. The land is largely Orangeburg and Norfolk soils, with the exception of that lying near the Gulf. This means a clay subsoil, and it follows that the land can be built up with legumes, and also that moisture will be retained, both of which are quite essential to economical horticultural practices. West Florida is well supplied with rivers, branches, springs and lakes. There are several leading horticultural crops which will be discussed individually.

PECANS

In northwest Florida there are more acres devoted to growing of pecans than to any other horticultural project. The oldest pecan trees are at Newport and are seedlings. The improved varieties were not planted commercially before about 1907. From this time on, large and small plantings were made at an increasing rate until about 1917. A planting of 1,000 to 3,000 acres was not uncommon.

It is the general opinion that it takes a lifetime to bring a pecan tree to the bearing stage. That was almost true of the seedling but the improved varieties can be brought into bearing at a very early age if proper care and fertilization is given. Also some varieties start to bear much sooner than others. The Moore bears younger with us than any other variety and Moneymaker second. A Moore orchard of fifteen acres in Jefferson County in its sixth year bore about 4,000 pounds of nuts.

Other leading varieties are Stuart, Schley and Success, but all three of these varieties are subject to certain insects and fungus diseases that make them unsuitable for Florida conditions, unless you are prepared to spray. The Moore and Moneymaker seldom have to be sprayed.

Pecans are usually planted in Florida 50 x 50 feet apart, or seventeen per acre, and they will do better on the hills than in the valleys. A pecan tree is a heavy feeder and until the soil has one and one half to two per cent humus content, a summer and winter cover crop should be grown. After that period is reached, one leguminous cover crop turned under each year is sufficient. In addition, the trees require a liberal application of commercial fertilizer. One very successful grower uses as many pounds of commercial fertilizer per tree as the square of the diameter of the tree. A pecan tree twenty years old can easily use fifty to 100 pounds per tree. Nitrogen is found to have the most effect on production of nuts.

The Austrian Winter Pea is probably the best winter cover crop for the pecan orchard. It is planted from September 15th to October 15th and must be inoculated. Some prefer one-half Austrian Winter Peas and one-half Monantha Vetch, which is good. This crop should be plowed under in late March or early April.

The summer cover crop is usually in by May 15th. Velvet beans, cow peas and beggarweed have been the main summer cover crops until recently. Only Brabham or Iron Cow Peas should be used, and these must not be used in a bearing orchard on account of being a host for the common pumpkin bug. Since Crotalaria Spectabilis has been introduced, it is replacing, to a large extent, the other legumes mentioned. Crotalaria Spectabilis is not a host to the pumpkin bug and will give more green weight, and more nitrogen per acre than any other legume. It will do well on sour or alkaline soil. It is not uncommon to obtain 30,000 pounds to 40,000 pounds green weight per acre. The weed is brittle and easy to disc under either green or dry. Another advantage of Crotalaria is that it will reseed itself.

The secret of success with pecans is to plant suitable varieties for your district, plant them on your best land and give them the very best of care — including turning under plenty of leguminous cover crops.

SATSUMAS

The Satsuma Orange occupies the next largest acreage in northwest Florida.

The only commercial variety planted is the Owari on Citrus Trifoliata stock. This reaches the markets in early November and usually brings very good returns for good packs, as they reach the market ahead of heavy shipments of round oranges from South Florida. On account of its size it is packed in straps, or one-half size boxes instead of full size orange boxes.

It is an excellent quality orange of the kid glove type. The rind is easily removed, and the sections are easily separated. It seems that the quality of the Satsuma increases as its northern limits are reached, and in northwest Florida it obtains its highest quality.

A new variety called Wase, will likely be planted to a considierable extent in the near future as it matures at least a month earlier than the Owari.

Very heavy plantings of satsumas were made in northwest Florida from 1914 until the severe cold of 1917. A good many orchards were badly hurt that winter, which caused large developments to cease.

Since 1917 we have had two winters almost as cold and again some damage was done. It was then observed that the trees located on hills and which had good care and fertilization were

not seriously hurt. It is now known to be a fact that if a satsuma tree is not kept free of white fly, or other insects and diseases, and well fertililzed so as to go into the dormant stage in the best of condition, it is likely to be injured by a severe cold spell. A good healthy tree is not injured, or. at least to any extent, by the winters of northwest Florida.

A satsuma tree under five years of age is much more tender and more subject to injury from cold weather, than the older trees. For that reason the young trees should be banked with clean sandy soil each fall. The mound should be removed in the spring.

Humus is again an important factor for success with satsumas. No doubt Crotalaria Spectabilis will soon supersede other cover crops, as it gives such a heavy tonnage to turn under, and since it is not a host to the pumpkin bug. A winter cover crop is not advisable as that would increase the chances of the trees being injured by cold.

It seems three applications of commercial fertilizer is best. The first application to be made usually about the first of March, the second the first to middle of June and the third the last of August. The first two applications should contain the usual three elements, but is best to omit the nitrogen in the third application, as it might cause the trees to grow too late in the season.

The satsuma orange is now of considerable importance in northwest Florida.

BLUEBERRIES

Blueberries are now occupying a good deal of attention in west Florida in particular, and shipments will soon be very substantial.

The first commercial planting was made at Crestview about 1893 by the late M. A. Sapp. The planting was made from plants found growing wild in that vicinity. This orchard is still in good condition, and bearing well.

At the present time most of the blueberry plantings are in Okaloosa, Bay, Santa Rosa, Jackson, Escambia and Walton Counties in northwest Florida. They are named in the order of importance. Okaloosa County probably has as many acres planted to blueberries as the rest of the counties combined.

There are several species of blueberries found growing wild in different parts of the State, but only the tall growing, usually termed the "Rabbit-eye" blueberry, is considered as having commercial possibilities. These plants grow to a maximum height of fifteen feet and are more of a bush form than that of a tree. Sprouts keep coming up from the roots and these are used for new plantings.

The fruit is borne in clusters and on the previous year's wood growth. The size of fruit varies from one-quarter to eleven-sixteenths inches in diameter, the average being about three-eighths. They are black or blue-black in color. They begin to ripen in late May or early June and last from ten to twelve weeks. As the earliest of the northern blueberries do not ripen till late in June, it will be noted that Florida blueberries have no competition for at least three weeks. Blueberries are shipped in quart cups in sixteen to twenty-four quart crates.

If good sized plants are used and given good care, a commercial crop will be produced the third or fourth year. Thrifty plants should produce four to seven quarts by the fifth or sixth year, and increasing each year. Trees are considered mature at twelve to fifteen years of age. They should produce twelve to sixteen quarts per plant, if well cared for, when they are ten to twelve years of age. In some cases individual plants have produced as much as sixty quarts.

It is preferable to make plantings in December, but will give satisfaction if planted in January and February. Since the mature plants have a spread of some fifteen feet, they should not be planted closer than 18 x 18 feet, and probably 20 x 20 would be preferable.

Clean and shallow cultivation is the practice so far. Five hundred to 800 pounds of 4-8-4 commercial fertilizer is used per acre, depending on size and age of plants.

Pruning has not been practiced as a rule. However, experimentally, it has been shown that severe cutting back of old plants has resulted in

greatly increased yields in the second or third year after. Spraying so far has not been necessary.

It is considered a profitable crop.

TUNG OIL

Tung oil seeds were introduced from China and only in recent few years has the tree been planted on a commercial scale.

Only in the last two to four years have tung oil trees been planted in northwest Florida, and not yet to a very large extent. However, it has created a great deal of interest and considerable acreage is already planted, with more to follow.

On account of the good type of soils in northwest Florida, it has been found the tung oil grows faster and produces nuts earlier in years, than where planted on the lighter soils.

The oldest tung oil tree in Florida is at Tallahassee and was planted by W. H. Raynes in 1906, the tree being produced by one of the first nuts introduced by the U. S. Department of Agriculture. It is still living.

Most of the plantings so far have been with trees grown from seed. There seem to be two general types, known as single and cluster types, due to the way the nuts are borne on the tree. In the past few years attempts have been made, by a few, to propagate by budding some of the better strains.

The nuts contain an oil that is used in the best paints and varnishes and also used for waterproofing materials. No doubt there is a good demand for this oil in the United States. Up to the present time most of the oil has been imported from China. But the imported oil is quite inferior, due to methods used in China, and due to adulterations.

The trees, if well cared for, will bear a commercial crop in from four to six years and will increase in yield annually until the trees are mature in age. This will likely be in about fifteen to twenty years from date of planting.

In planting tung oil acreage, be sure to select land with good drainage, and preferably on a hill, as the bloom appears very early and is subject to late frost damage. An acid soil seems best. The trees will respond to good cultivation and fertilization.

It is the present practice to grow a summer cover crop in the middles. Crotalaria is used in most cases and for northwest Florida conditions, Crotalaria Spectabilis is best. Like all other trees, tung oil trees require a great deal of humus.

There seems to be a good future for the tung oil industry.

PEACHES

Commercial peach growing so far has not proven so profitable in northwest Florida. This is partly due to nematodes and partly due to a lack of suitable varieties.

The commercial varieties used in middle and northern Georgia do not do well. These varieties require a little more cold in the winter time than is usually had here, and too, those varieties are subject to blooming any time in the winter, and then the blooms are often killed by late frost.

Two hundred and fifty acres of Hileys, Elbertas, Carmen and Georgia Belles were planted about 1924 near Monticello, and 100 acres of similar varieties at Marianna previous to that. They were both commercial failures.

However, with nematode resistant root stock and suitable varieties, peach growing may be made profitable in northwest Florida. The clay subsoils give the right condition and, too, the peaches can be placed on the market ahead of those from Georgia, thus obtaining good prices.

In the meantime, before making a commercial planting of peaches, a few trees of various varieties and on nematode free root stock, should be given a thorough trial.

PEARS

Before the pear blight arrived there was considerable acreage of pears in northwest Florida, but the blight has eliminated the old orchards.

Lately, blight-free or blight-resistant varieties of pears have been introduced and plantings have been made to some little extent. Most of these varieties of pears, however, are suitable for canning, rather than eating.

PLUMS

Plums so far are of no commercial importance in northwest Florida. Where well cared for and sprayed properly, however, they seem to have promise.

SUMMARY

In order to get some definite idea of the acreage planted to each of the above mentioned crops in northwest Florida, a letter was sent to each county agent for information. No report was received from Bay, Gulf, Franklin and Gadsden Counties. Some of the data given was obtained from other sources. It is not claimed that the following data is accurate but will give some idea of the prominence of each crop mentioned above:

Satsumas

Acres Bearing	Acres non-Bearing	Amount Shipped Crates	County
55	40	2,226	Santa Rosa
2			Liberty
40	10		Calhoun
1,000	500	50,000	Jackson
35	15		Leon
75			Holmes
		(straps)	
75	30	5,000	Walton
300		6,000	Washington
600	100	22,000	Escambia
150	50	500	Jefferson
100	500		Okaloosa
2,432	1,245	85,726	

Blueberries

Acres Bearing	Acres non-Bearing	Amount Shipped Crates	County
70		1,000	Santa Rosa
25	5		Calhoun
50			Jackson
20			Leon
150			Holmes
160	40		Walton
15			Washington
300		few	Escambia
	20		Jefferson
1,500	500		Okaloosa
2,290	565	1,000	

Tung Oil

Acres Bearing	Acres non-Bearing	Amount Shipped	County
	400		Jackson
70	200		Leon
100	200	few	Escambia
10	400		Jefferson
	1,400		Okaloosa
180	2,600		

Peaches

Acres Bearing	Acres non-Bearing	Amount Shipped	County
50			Jackson
100			Holmes
5			Washington
100	100		Escambia
255	100		

Plums

Acres Bearing	Acres non-Bearing	Amount Shipped	County
25			Jackson
10			Holmes
½			Washington
100	100		Escambia
135½	100		

Pecans

Acres Bearing	Acres non-Bearing	Amount Shipped Pounds	County
900	5,000	329,800	Santa Rosa
20	4		Liberty
150	20		Calhoun
500	100	200,000	Jackson
10		3,000	Dixie
600	150		Leon
700			Holmes
600	600	15,000	Walton
75	125		Hamilton
810	90		Washington
6,000	50	400,000	Jefferson
700	200	70,000	Escambia
1,500	2,000		Okaloosa
12,565	8,339	1,017,800	

Pears

Acres Bearing	Acres non-Bearing	Amount Shipped Cars	County
55	55	4	Santa Rosa
7	3		Liberty
10	5		Calhoun
50			Jackson
20			Leon
200			Holmes
30	15		Walton
10	30		Washington
100	100		Escambia
	10		Jefferson
800	200		Okaloosa
1,262	418		

THE CULTURE OF PINEAPPLE ORANGES ON THE HIGH PINE LANDS

F. M. O'Byrne, Lake Wales

The Pineapple Orange originated on heavy soil near Sparr, Fla. It was first propagated by the Bishop-Hoyt Fruit Company, H. B. Stevens, manager, of Citra. This grove is now owned by Messrs. Crosby and Wartmann of Citra.

For many years practically all Pineapples were budded into sour orange seedlings and were planted on hammock soils or the heavier pine soils. They produced a fine orange of vigorous habit, deep orange color and splendid eating quality with a peculiar and characteristic aroma.

Early in the present century some ambitious persons began to develop extensive grove holdings in the very thin high pine lands of Polk, Lake and what is now Highlands Counties. It was found that trees budded into sour orange made a very slow growth in these very light thin soils. Other stocks were tried and rough lemon was selected as the one best suited to very light soil.

About 1912 extensive citrus plantings were started in some of the lightest portion of the high pine lands, all on rough lemon stock. Many of these groves contained a block of Pineapple Oranges.

When these trees came into bearing it was found that the Pineapple Oranges they produced differed considerably from the Citra Pineapple. The oranges were not as smooth in texture or as thin of skin as the Citra pineapple. The color was not as deep nor was the fruit as tart. Pineapples on rough lemon stock will mature earlier than those on sour orange.

But the greatest difference noted was in habit and vigor of growth. The Pineapple on sour orange root in heavy soil is a vigorous grower. On rough lemon root it has a tendency to grow up and it lacks vigor. It tends to overbear, to grow hard and frenched and to lose much wood from withertip. During periods of drouth it is

apt to suffer severely often half of the top dying back and having to be cut out.

One trouble is that the grower of Pineapple Oranges in the sand hill sections wants to get his crop off early before his brother grower on sour orange stock starts to ship. In other words, the Pineapple grower in the sand hills tries to crowd into the Parson Brown and Hamlin orange season.

Pineapple Oranges in the sand hills, to be kept in good vigorous condition, should receive an application of fertilizer in August. But this will keep them growing and seriously delay maturity. Some growers follow the practice instead, of waiting till the fruit will pass the maturity test, then apply an application of nitrate of soda and pick the fruit about a week later before the nitrate has a chance to put the fruit back where it will not pass the test. Should a good rain fall after the soda was applied and before a grower could pick the crop, the fat would be in the fire. He would market his Pineapples after December first.

Some growers apply the soda the day the crop is picked. This is not soon enough. Pineapples particularly go back badly after the crop is picked. If it happens to be quite dry at this season and the grove has no irrigation system, half of the top may die with plenty of food on the soil simply waiting for a rain.

Some growers say they prefer to have their trees rather than good prices for what few Pineapples they can raise so they apply an extra application to their Pineapples in August and make no effort to ship the fruit till time for the Christmas trade.

The Pineapple Orange loves organic fertilizer, whether it comes in the fertilizer bag, is applied as manure or as a cover crop or hay mulch hauled in from the outside.

The writer favors the practice of applying organic fertilizers in considerable quantities to Pineapple Oranges in the fall by turning in a heavy cover crop or hauling in a mulch or stable manure. Castor Pomace applied under the branches is excellent.

A good generous application of fertilizer should be given in November, February and again in May. If this is done the Pineapples will generally carry through to maturity without a supplemental application. If the trees show signs of going back during August, pay attention to the danger signal; for it is better to delay the maturity of one crop than lose half of your bearing surface from withertip.

One other point of importance — irrigate or water Pineapple trees during a drought as soon as they show they are needing water. If you neglect them too long withertip will set in and then it is hard to stop. One should not figure on what he will save alone in the way of fruit, but also on what he will save in a pruning bill and loss of bearing surface if he will properly watch his Pineapples, during a drought.

Some growers, disheartened by their troubles with Pineapple Orange in the sand hills have decided to top work their trees. This I think is a mistake. One could hardly work them over to another orange because of the impossibility of telling what sprouts come from buds and what ones from the Pineapple stock. This leaves you only grapefruit, tangerines or Temples to consider for the new top.

Nothing in recent years would encourage one to select tangerines for the new top. With large plantings of grapefruit in Texas, one should hesitate to consider grapefruit for a while at least. While the Temple has done famously in the sand hills the last two years, we can not be absolutely certain that we have learned how to handle it. Weather conditions may have played a greater part than our feeble efforts. I think it too soon to hail the Temple orange as an unqualified success on rough lemon stock.

As a matter of fact, with all its drawbacks, the Pineapple Orange has made the writer more money in recent years than any other variety except Valencias which have been the best variety in our section. My advice to the grower who is thinking about top working his Pineapples is, "Don't do it." Baby them along a little, watch them during mid-summer and during droughts. Feed them a little extra when they get hungry or hard and they will bear you more fruit than any other orange and will produce nearly as high a per-acre return as any variety you can grow.

CLITOCYBE MUSHROOM ROOT-ROT — A NEW CITRUS ROOT DISEASE UNMASKED

Dr. Arthur S. Rhoads, Florida Agricultural Experiment Station, Cocoa

As a result of the great publicity given to foot-rot, it has grown to be the custom in Florida when citrus trees decline from a more or less slow dying of the main roots and girdling of the bark at the base of the tree in a manner which can not be attributed to any other cause, to attribute the trouble to this well known disease. Although the organism causing foot-rot has been isolated repeatedly and identified as *Phytophthora parasitica,* and it has been possible to reproduce the disease by inoculations with this organism, but little is known in regard to infection, development, and general behavior of the casual fungus under grove conditions. It is probably due in a large measure to our lack of specific knowledge in regard to fot-rot that we have been so free in arbitrarily assuming that this disease is invariably the cause of the symptoms we have come to associate with it.

While it is undoubtedly true that foot-rot has taken a heavy toll of citrus trees in Florida, especially among the sweet orange groves and trees budded on this stock, it has been found that there is aother important disease of rather widespread occurrence which works similarly to foot-rot and which has been confused with it in the past. To be more specific, the speaker has found that, in a number of sections of the state, many citrus trees which were thought to be dying from root-rot were dying from Clitocybe mushroom root-rot instead. We firmly believe that many errors of diagnosis have been committed in the name of foot-rot and that this well known disease has had to bear far more than the share of blame which should be justly attributed to it as a factor in citrus tree loss.

The speaker first called attention to the occurrence of this disease in Florida before this Society at its 1930 meeting.* Since then, it has been discussed in various articles published subsequently or broadcast by radio. Since additional information on this disease continues to be obtained from time to time, an attempt will be made to briefly present the information available to date in regard to it so that citrus growers may become sufficiently familiar with it to be on the lookout for it and that they may know how to handle it should it be found to occur in their groves.

*Rhoads, Arthur S. Some new or little known citrus diseases observed during the past year. Proc. Florida State Hort. Soc. 1930: 80-88, 1930; also in Citrus Industry **11** (5): 3-7, 34, 6 figs. May, 1930.

OCCURRENCE IN FLORIDA

Clitocybe mushroom root-rot, which is known to attack fruit trees, grapevines, forest, shade and ornamental trees, and shrubs, occurs in a number of the southern states ranging from Florida and North Carolina on the Atlantic Coast west to Missouri, Oklahoma and Texas. Old photographs by Hume in the files of the Experiment Station furnish positive proof that this root-rot disease was known to occur in Florida as early as 1902, which is just one year after Wilcox described it from Oklahoma. It is recalled by Hume that this disease constituted an important source of loss to peach growers of some sections of the state in former years. The fungus causing this root-rot appears to have been native to timbered lands of a number of the southern states and to have spread from these orchards, vineyards, and various trees and shrubs planted after the land was cleared.

Numerous cases of Clitocybe mushroom root-rot have been recorded, by the speaker and his associates at the Exxperiment Station during the past nine years, attacking a large variety of woody plants in various parts of Florida. This growing list has been supplemented somewhat by specimens of plants attacked by this disease which have been sent for diagnosis. At present our records of the occurrence of this root-rot in Florida comprise more or less scattered points ranging from Jacksonville to the western border of the

state and south in the peninsula to Ft. Lauderdale on the East Coast, Lake Placid and Nocatee in the central part, and Oneco on the West Coast.

Despite a large array of records of the occurrence of Clitocybe mushroom root-rot in various parts of Florida, however, it was not until specimens of diseased citrus roots were sent from Lake Alfred in December, 1929, for diagnosis that citrus trees were definitely known to be attacked by this particular root disease. However, it had been known for several years that the closely related foot-rot fungus, *Armillaria mellea,* has proved quite destructive to citrus trees in California and a number of foreign countries. This first record of the occurrence of the Clitocybe mushroom root-rot on citrus was verified by an early visit to the grove in question. Subsequent field observations and studies have brought to light the occurrence of this root-rot of citrus trees in a number of groves at various points in Polk County, in three groves in Brevard County, and in at least one in Lake County. In all, fully 175 citrus trees have thus far been found to be attacked by this disease. In a number of localities it was found that the growers were simply attributing their tree loss to that old reliable alibi—root-rot, without knowing the difference. An idea of the prevalence of this root-rot disease in one locality may be gained by stating that grove inspections over a period of about two years in a number of groves under the management of one company at Lake Alfred have led to locating seventy-seven trees attacked by Clitocybe mushroom rot-rot out of a total of forty odd thousand, or about 700 acres of grove. Since these groves average about sixty trees per acre, the total number of attacked trees would comprise approximately 1¼ acres out of the 700.

The citrus trees found attacked by Clitocybe mushroom root-rot in Florida have varied from scattered individual trees to groups of trees, and even areas of grove involving approximately one-half acre in extent. It is interesting to relate that, with the exception of three old sweet seedling orange trees recently located in a grove at Rockledge, all have been on rough lemon stock. The latter trees have ranged in age from approximately nine to twenty years. The three seedling orange trees were probably fully forty years of age. All of these trees occurred on well-drained high sandy land. The trees budded on rough lemon stock comprise mostly gropefruit trees, with some orange, a few tangerine trees, and a single young Tahiti lime.

The remarkable extent to which this trouble has been found to occur on the strength of preliminary investigations in a few fairly young groves where the trees appeared quite healthy above ground indicate that it is a problem for serious consideration. From the widespread occurrence of the Clitocybe mushroom root-rot fungus on a diverse array of plants throughout the majority of the state and the numerous records obtained of its occurrence on citrus trees in a few localities since its discovery at the end of 1929, it is undoubtedly likely that this disease will, with sufficient opportunity for field reconnoissance, be found to be of fairly widespread and common occurrence in citrus groves, at least throughout the central portion of the peninsula, where the rough lemon rootstock is universally used and oak trees are prevalent.

SYMPTOMS

The symptoms exhibited by citrus trees attacked by Clitocybe mushroom root-rot vary greatly with the duration and progress of the disease. In the majority of the large number of attacked trees whose root systems have been exposed for study and treatment, although the disease had obtained considerable headway, there was no appreciable decline of the tops and these trees appeared as good and as productive as the adjoining trees which were not attacked. In most cases, however, these trees were located solely by finding either fresh or old clusters of the mushrooms of the Clitocybe root-rot fungus at the bases. Upon removing the soil from about the root crowns of these trees, however, a number of the lateral roots were found to be dead in all cases, these often being dead clear back to the root crown and with the terminal portions rotted. In most of these cases the taproots were also dead. In some cases an area of bark was found to be dead at one side of the base of the trunk and a slight exudation of

gum occurred just above. These areas of dead bark frequently marked the point where a large lateral root had been killed back to the root crown and usually were places at which one or more clusters of the mushroom or toadstool fruiting bodies of the fungus had developed.

It was equally surprising to find that oak and occasionally other hardwood roots extensively invaded by the mycelium of the Clitocybe root-rot fungus were found under a large percentage of the attacked citrus trees studied in the central part of the state and that some of these infected roots were in contact with one or more roots of the citrus trees in apparently all such cases. The inference is that these roots which were left in the land at the time of clearing became infected by the Clitocybe root-rot fungus and that they served to transmit the fungus to the roots of the citrus trees. It was also observed in several instances that where an infected citrus root crossed or otherwise came into contact with other citrus rots the root-rot fungus was transmitted to these roots.

In some of the attacked citrus trees studied in the central part of the state, and in most of those studied in Brevard County, however, no oak or other hardwood roots were encountered. Furthermore, oak and other hardwood roots have been absent under probably the majority of the other numerous miscellaneous attacked trees and shrubs which have been dug up for examination. From this it would appear that while the presence of foreign tree roots left in the ground when the land is cleared greatly predisposes the planted trees to infection by the Clitocybe mushroom root-rot fungus, this fungus may also live and spread through the soil in the absence of dead roots.

The majority of the attacked roots of citrus trees which have been studied, as well as the old oak and other hardwood roots encountered under them, exhibited an abundant development of the mycelium, or vegetative growth, of the Clitocybe root-rot fungus, except in those cases where they were fairly well decayed or the growth of the fungus had run its course in competition with other soil organisms. In citrus trees the fungus rarely develops much above the ground line, although it usually develops upward for at least a few inches on other trees. The mycelium, or vegetative portion of the fungus, varies from thin, filmy white wefts with a radiating marginal growth to whitish, creamy yellowish or chamois-colored papery layers of extensive development between the bark and the wood and also permeating the inner bark. Freshly dug roots in which the mycelium of the root-rot fungus is still active have a pronounced mushroom or fungus odor. The wood of the larger attacked roots often develops both radial and concentric cracks, filled with sheets of mycelium. This invasion of the wood has even been observed to extend into the butt of the tree, causing a heart-rot at this point. In well-advanced cases of the disease the root-rot fungus causes a whitish decay of the deeper roots and the decayed wood is often watersoaked and may even become plastic in the late stages of decay.

The attack of the root-rot disease generally appears to be concentrated close to the base of the tree and on the adjacent portions of certain lateral roots, as in foot-rot, the disease spreading gradually to other roots and even to adjoining trees. When the roots become girdled by the spread of the fungus from the root crown or from other rots the end, or distal, portions soon die regardless of whether they were invaded by the fungus or not. In some cases areas of dead bark varying from a few inches to a foot or more in length extend along the living main lateral roots. Such areas were often found to have become delimited by the formation of a callus around the periphery, in which case the mycelium of the fungus appeared to die and the dead bark eventually disintegrates and sloughs off. Rizomorphs, which are specialized strands of fungous mycelium chiefly on the surface of the attacked roots and through the soil by certain mushroom root-rot fungi, as a rule appear to be lacking or to occur with great rarity, not only on citrus trees but also other woody plants. In certain instances, however, both in citrus and other trees, a peculiar development of black hardened, stroma-like masses of mycelium were found to have developed out of longitudinal fissures in the bark, sometimes forming a network-like pattern. Such structures appear to occur more

or less commonly in the case of the root-rot caused by the well known honey agaric or oak-foot fungus (*Armillaria mella*) and have been designated as rhizomorphs by some investigators. Accompanying these structures on attacked citrus roots, numerous black, bristle-like rhizomorphic structures were often found protruding a short distance through the bark at right angles to the growth axis of the roots. These are very brittle, however, and are readily broken off in removing the dead roots.

By the time the mushroom root-rot fungus has invaded a portion of the root crown and sufficient of the roots to interfere seriously with the support of the top of the tree its decline follows rapidly, very similarly to a tree attacked by foot-rot. The foliage on the most severely affected branches becomes pallid and somewhat smaller than normal and the leaves bleach out along the midribs as is invariably the case with acute starvation of citrus trees induced by any form of girdling. The most seriously affected branches die back rapidly and the fruit produced on these devitalized branches is usually small and frequently drops before reaching maturity, due to the rapid decline of the top of the tree. By the time the top of the tree has begun to decline, lesions of dead bark, similar to those developed in root-rot, often develop at the base and the bark may crack and gum more or less freely. Dead lateral roots may be evident in many cases, even without scraping away the soil to any particular extent.

In other miscellaneous trees and shrubs attacked by Clitocybe mushroom root-rot the symptoms of the disease are also quite variable. While certain trees and large shrubs may show a few peliminary but inconspicuous symptoms, in the majority the foliage simply dries up and dies suddenly, especially during periods of drought, and plants which appear to be healthy may be dead within a short time. In fairly thin-barked trees such as Australian pines, guavas and Surinam cherry, a more or less conspicuous lesion or cracked area of dead bark often develops at the base of the attacked tree a considerable period in advance of their death. This usually marks the progress of the fungus around the root crown and base of the tree. In some instances sunken basal lesions occur, caused by the bark dying at this point while remaining green and continuing growth above for a considerable period before death ensues. Thick-barked trees such as oaks and eucalypts naturally do not develop basal bark lesions but die with the bark intact.

The symptoms of mushroom root-rot attack appear to register better in the so-called Australian pine trees than in any other tree that has been observed by the speaker. In these trees, when the decline is gradual, the presence of the disease may be detected in advance by a yellowing of the foliage branchlets, either on the lower branches or scattered more or lesss throughout the crown of the tree. This is followed by a gradual shedding of the foliage branches, which the layman regards as needle-like leaves, and this may continue until the tree is defoliated. In other cases, however, no appreciable yellowing of the foliage branches may precede the gradual defoliation. In some cases, after considerable defoliation, a new growth of foliage branches develops but these are only about half as long as they would be normally. In such cases the tree may thus linger for from a few months to a year or so longer before it dies. In still other cases, however, especially in young trees, death takes place so rapidly that the green foliage simply starts to turn brown and dries up simultaneously over the whole tree before much defoliation takes place. The rapidity with which the death of trees and shrubs attacked by mushroom root-rot frequently takes place calls to mind the old adage, "Here today and gone tomorrow."

Of course, this is not really true since the roots of the attacked trees have been dying for some time. This progresses for a considerable length of time before the layman even has cause to suspect that anything is wrong with the tree. By the time the death of the root system has attained such a development as to cause certain symptoms of distress to register in the top the tree is usually pretty well done for—in fact, much more so than one would judge from the appearance of the top. When girdling of the root crown progresses sufficiently to cut off that highly important function of water conduction the vital processes of the tree cease and it suddenly dies.

OTHER PLANTS ATTACKED

In addition to citrus trees, Clitocybe mushroom root-rot has been found to attack a great variety of fruit, shade and ornamental trees, hedge anc ornamental shrubs in Florida. These comprise both native and exotic plants introduced from various parts of the world. A complete list of the trees and shrubs thus far found to be attacked by this disease is given as follows:—

Fruit trees and vines

Citrus (grapefruit, orange, tangerine and Tahiti lime) trees on rough lemon stock, sweet seedling orange trees, apple, apricot, avocado, bananas (Dwarf Cavendish, Hart's Choice or Lady Finger, and Orinoco or Horse), grapes, guavas (common, Cattley and Mexican), Japanese persimmon, loquat, peach, plum, sand pear, Surinam cherry, cherimoya (*Annona cherimola*), soursop (*Annona muricata*), *and Java plum* (*Eugenia jambolana*),

Miscellaneous trees

arbor-vitae (*Thuja occidentalis*)
biota (*Thuja orientalis*)
Chinese arbor-vitae (*Thuya orientalis*)
Lawson cypress (*Chamaecyparis lawsoniana*)
sand pine (*Pinus clausa*)
slash pine (*Pinus caribaea*)
southern red cedar (*Juniperus barbadensis*)
Canary Island date palm (*Phoenix canariensis*)
Australian pines (*Casuarina equisetifolia, C lepidophloia,* and other species)
Chinese tallow tree (*Sapium sebiferum*)
dogwood (*Cornus Florida*)
eucalyptus (*Eucalyptus robuta and other* species)
laurel cherry (*Laurocerasus caroliniana*)
laurel oak (*Quercus laurifolia*)
turkey oak (*Quercus catesbaei*)
water oak (*Quercus nigra*)
pithecolobium (*Pithecolobium dulce*)
rose apple (*Eugenia jambos*)
royal poinciana (*Delonix regia*)
trumpet tree (*Cecropia palmata*)
tung-oil (*Aleurites fordii*)

Miscellaneous Shrubs

acalypha (*Acalypha marginata*)
althaea (*Hibiscus syriacus*)
castor bean (*Ricinus communis*)
Confederate jasmine (*Jasminum pubescens*)
cotoneaster (*cotoneaster* sp.)
crotalaria (*Crotalaria striata*)
hibiscus (*Hibiscus rosa-sinensis*)
ixora (*Ixora coccinea*)
jasmine (identity unknown)
oleander (*Nerium oleander*)
pittosporum (*Pittosporum tobira*)
poinsettia (*Euphorbia pulcherrima*)
privet (*Ligustrum* sp.)
rose (*Rosa* sp.)
rose bouquet (*Assonia punctata*)
Turk's cap hibiscus (*Malvaviscus grandiflorus*)
Viburnum (*Viburnum odoratissimum*)

Clitocybe mushroom rot-rot constitutes a most important source of loss in the numerous Australian pine plantings in many parts of central and southern Florida, the three widely planted species of this tree being especially susceptible. Not only does this root-rot fungus spread rapidly from one attacked tree to adjacent healthy ones, especially where the trees are closely planted as in windbreaks, but small trees set out to replace ones that have died from rot-rot become infected and die at an early age. The heavy mortality caused by this root-rot fungus in Australian pine plantings has caused considerable concern upon the part of developers of subdivisions, garden clubs, and individual planters. The destruction of the Australian pine plantings is especially severe on the higher lands where oak trees occurred prior to clearing. On prairie and muck lands in the drainage districts, and in those portions of the state where oak trees do not occur, the disease seems to be of rare or infrequent occurrence.

The Clitocybe root-rot fungus also takes a rather heavy toll of various ornamental trees and shrubs used in landscaping home grounds. The speaker has found by repeated experience that many people conntinually lose promising trees and shrubs as a result of attack by this fungus without ever having the remotest conception of the real cause. In a number of instances where he has been called upon to diagnose the cause of death of some tree or shrub and has found the trouble to

be root-rot, a careful investigation has disclosed the loss of others on the same property from the same cause. In some cases the continued loss of valued trees and shrubs from this disease becomes quite distressing to the owner.

The question is often raised as to whether or not we can find some trees and shrubs to plant that will be resistant to attack by the Clitocybe root-rot fungus. Judging from the omnivorous nature of this fungus as evidenced by the wide variety of plants attacked, which include not only such great groups of woody plants as monocots, dicots and conifers, but also such herbaceous plants as bananas, the prospect of finding useful plants that are resistant does not appear to be very promising.

CAUSE

The organism causing this root-rot is one of the gill fungi, *Clitocybe tabescens* (Scop.) Bres., popularly termed mushrooms or toadstools, which fruits in clusters comprising several individuals developed from a common base, usually at the base of the attacked tree. This fungus has been found associated repeatedly with attacked citrus trees and has been isolated on numerous occasions in cultures made from the roots of citrus and other trees found attacked by root-rot in various parts of the state. While working in Missouri a decade ago, the speaker demonstrated this particular fungus to be the cause of a root-rot of grapevines.* The root-rot caused by this fungus very closely resembles that caused by the well-known honey agaric or oak-root fungus (*Armillaria mellea*), especially in regard to habit of growth, the production of rhizomorphs, appearance of the mushroom-like fruiting bodies, growth in artificial cultures, and prevalence on land where oak trees have occurred.

The Clitocybe root-rot fungus is propagated by means of the myriads of spores developed on the gills of the fruiting bodies, from infected roots that may be in the soil, and by means of the whitish to tan-colored or brownish fungous strands, or rhizomorphs, which are developed under certain conditions. The latter develop readily in artificial cultures of the fungus and furnish one of the chief means of identifying the organism before the mushroom fruiting bodies are produced. However, the closely related Armillaria root-rot fungus, which is also known to occur in the northern part of the state, likewise develops very similar rhizomorphs in artificial cultures, so that there is a possibility that these two root-rot producing organisms may be confused, in the absence of the mushroom fruiting bodies, not only in the field but also in the laboratory.

Since the Clitocybe root-rot fungus can penetrate roots through uninjured bark and can invade living tissue readily it must be regarded as an active parasite of living trees. It also flourishes as a saprophyte in old stumps and roots of various trees, especially oaks. The clusters of the mushroom-like fruiting bodies are developed after the mycelium has attained a certain extent of development, provided the moisture and temperature conditions are favorable. The season of their occurrence in Florida is chiefly from October to early December but they may develop at almost any time during the year under favorable growing conditions. These mushroom or toadstool clusters are sufficiently distinctive that they should not be confused with other mushroom or toadstool fungi which may occur around trees occasionally but be without any pathological significance. The caps, which develop readily under favorable conditions after reaching the "button" or differentiated stage, are strongly convex at first, changing to umbonate and finally becoming flattened or more or less strongly depressed from the elevation of the margin resulting from continued growth. They are whitish when young, becoming light tan to drab, the surface being tomentose at first and often later adorned with tawny olive scales or fibrils. The caps vary from two to three and one-half, or sometimes four inches in diameter, the size varying with the growth conditions and number of mushrooms developed in a cluster. The clusters attain their full development within a few days under favorable conditions and decay very quickly in warm weather, leaving a more or less circular blackish crust on the ground. However, if dry

*Rhoads, Arthur S. Root rot of the grapevine in Missouri caused by Clitocybe tabescens (Scop.) Bres. Jour. Agr. Research **30** (4): 341-364, pls. 7. 1925.

weather follows their development, especially during the fall or early winter, they may dry up and remain recognizable for at least two to three months, and often much longer, thus marking the tree as undoubtedly one attacked by root-rot. In the absence of the fruiting bodies of the fungus the disease appears to be distinguishable from foot-rot only by finding the characteristic mycelial growth of the fungus between the bark and the wood of the rots, which is best done in those at least half a foot below the surface of the ground, where better moisture conditions prevail.

CONTROL

It is far easier to take steps to prevent the occurrence of mushroom root-rot than it is to control the disease after it develops in the grove. In clearing timbered land for grove sites, with the exception of low hammock land where it would be economically impossible, it is highly desirable to remove all roots as thoroughly as is practicable and to prepare the land by deep plowing, which will bring to the surface roots which probably were overlooked in clearing. This is especially important where oak trees occur on the land.

Unfortunately, no experimental work has been done in regard to the possibility of controlling Clitocybe root-rot, so that there is no precedent to go by. However, considerable valuable experimental work has been done in attempting to control the closely related Armillaria root-rot. From the known facts, it would appear that there is but little hope of saving trees attacked by either of these mushroom root-rot fungi without careful surgical work and aeration of the root crowns and adjacent roots. This calls for rather tedious and painstaking work which the average citrus grower seems desirous of avoiding.

The mycelium of root-rot fungi is very sensitive to drying out and the removal of the soil from under the bases of the attacked trees, so as to leave the root crowns and adjacent roots exposed for aeration and drying has proved to be very beneficial in checking their development, as it has in the case of foot-rot in Florida. Considerable experimental work has been done in attempting to control Armillaria and other root-rot fungi by various chemical treatments of the soil, both in this country and abroad, but without sufficiently consistent success as to justify any recommendations.

When trees in the grove are attacked by Clitocybe rot-rot the control measures will be determined largely by the local circumstances. Two main problems are presented: (1) the prevention of the spread of the disease to adjoining trees and (2) the treatment or removal of the trees already attacked. Probably the most effective method of preventing the spread of the disease when the attacked trees occur in a group is to isolate them by digging a narrow trench of sufficient depth to extend below all the communicating roots and cutting out all roots crossing from either side. The dirt removed should be thrown back to the inside of the area. A depth of from two to three feet will probably suffice ordinarily under Florida conditions.

In order to be effective, remedial measures must be applied before the disease has progressed to such an extent as to kill a large percentage of the roots and to partially girdle the root crown, since after the disease has progressed to this extent, the death of the tree is inevitable. Unfortunately, this extent of development of the trouble usually is reached before the symptoms of decline develop in the top of the attacked tree to warn the casual observer that something is wrong with the tree. However, attacked trees often can be located quite a while before the tops begin to decline, by finding the clusters of the mushroom-like fruiting bodies of the root-rot fungus, or sometimes only a slight gumming and dying of an area of the bark, at the bases of the trees.

Unless the top of the tree has declined considerably, the extent to which the disease has attacked the root system can be determined only by removing the soil sufficiently from around and under the root crown and adjacent roots. This requires removing a basin of soil with a radius of from two to three feet from the base of the tree, working carefully so as not to injure the roots. Unless facilities are available for washing, the soil should first be worked away from the root crown with a trowel and a pointed stick until a shovel can be used. One half of a posthole digger makes an

excellent implement to remove the soil under the root when the lateral roots lie close together.

If it is practicable to treat the tree, all dead roots should then be cut out, using a mallet and chisel or gouge to trim them back to the root crown. Special effort should be made to remove all oak or other foreign tree roots that may be encountered under the citrus trees being treated. All dead roots of either citrus or other trees which are cut out should be followed out to the ends and should be removed in their entirety. All bark lesions that may occur on the base of the trunk, root crown, lateral roots, or taproot, in case the latter is not entirely dead, should have the dead or infected bark cut out back to healthy bark and cleaned off down to the wood. Particular care should be taken to examine for lesions under the lateral roots, especially where these roots leave the root crown. Where lesions have ceased activity and have become delimited by a callus formation at their margins it will suffice to merely scrape off the dead bark down to the wood. All pieces and chips of wood and bark cut out should be collected in a container and piled at some convenient place for burning later. A piece of heavy paper placed under the tree will prove helpful in collecting the chips and small pieces of wood and bark cut out, which, if allowed to remain in the ground, may act as sources of infection. All trees not worth treating should be dug up, care being taken to remove and burn all roots. Where attacked trees are removed, it is advisable to leave the excavation open for a few months before replanting.

After completing the surgical treatment of the tree, the roots should be left exposed several days to promote drying and aeration, after which the treated areas should be brushed clean of sand and inspected for any bark infections that may have been overlooked, and all exposed wood surfaces should then be painted with a durable waterproof wound dressing. After this has dried the excavation may be filled in completely or the immediate root crown may be left exposed indefinitely if preferred. If the tops of the trees have died back they should be dehorned proportionately and pruned of all dead wood. The location of all treated trees should be recorded and they should be inspected periodically to detect any subsequent development of the root-rot fungus which may occur.

Upwards of a hundred citrus trees attacked by Clitocybe mushroom root-rot have been treated by the above method in different parts of the state in order to determine its efficacy. Although sufficient time has not elapsed since the treatment to judge the results, it appears that trees treated more than a year ago before the tops began to die still appear to have healthy productive tops, whereas in the comparatively small number of trees treated after the tops had begun to die back more or less do not look particularly promising—in fact, they have continued to die back in some cases. It is believed that the use of some good fungicide, such as Bordeaux paste or caustic soda Bordeaux, in conjunction with the surgical and aeration methods, will greatly expedite the eradication of the root-rot fungus. A few gallons of either of these fungicides poured into the basins of soil under the base of the treated trees and at other points where diseased roots have been removed should prove valuable in killing out any mycelium of the root-rot fungus which may be left in the soil.

CONCLUSION

In conclusion the speaker wishes to emphasize that Clitocybe mushroom root-rot of citrus trees is obviously no new trouble but that it simply has not been distinguished heretofore from foot-rot, which it closely resembles in the behavior of the attacked trees. Only a few days ago a Florida grove owner, reading in the March issue of the Florida Grower a brief item stating that the speaker had given a report of the discovery of a new mushroom root-rot of citrus trees at the recent meting of the American Phytopathological Society in New Orleans, wrote from a distant state, stating that he had experienced this trouble in his grove at Kathleen in Polk County about 1915 and that it has been causing trouble up to the present time. This grower described his experience with this disease in such accurate detail that there appears to be no doubt whatever that the repeated tree losses which he suffered were due to mushroom root-rot.

The failure in the past to distinguish Clitocybe

mushroom root-rot from foot-rot of citrus trees may well be the reason why some growers have considered the rough lemon rootstock to be quite susceptible to foot-rot. The publicity given to this destructive new disease of citrus trees should not alarm growers unduly since its indentification probably does not portend any added loss of citrus trees to that already experienced and attributed to foot-rot. The recogition and understanding of this new disease merely enables us to properly diagnose the cause of a part of our root troubles of citrus trees rather than to continue to assign them all arbitrarily to foot-rot for lack of better knowledge.

FIVE YEARS' TESTS WITH OIL EMULSIONS ON THE GROWTH OF CITRUS TREES

W. W. Yothers, Entomologist, Bureau of Entomology, United States Department of Agriculture, Orlando

GENERAL STATEMENT

The following paper is a preliminary report on a long-time experiment started sometime ago to determine the effects of several spray oils on citrus trees. This work was carried on, on a plot of ground leased from the Board of County Commissioners, Orange County, Florida, and planted to citrus trees. On December 9, 1926, we planted ninety-three Parson Brown buds which were one year old on three-year-old sour orange stock. Parson Brown variety was selected because it matures before danger from frost and because from a commercial standpoint the early fruit is the most seriously affected by the application of oil sprays in the fall. The sour orange stock was selected because this variety does not perfect itself on rough lemon stock and also because the land was adapted for the sour orange root stock. The trees were thrifty and there was an abundance of roots on them. The trees were planted twenty-six feet, eight inches, by twenty-two feet.

In order to make the report and records more complete, the plan of the little grove is here included:

PLAN OF GROVE

NORTH

	Row	Tree Numbers	
	1	1 2 3 4 5 6 7 8 9 10	
	2	1 2 3 4 5 6 7 8 9 10	
	3	1 2 3 4 5 6 7 8 9 10	
W	4	1 2 3 4 5 6 7 8 9	E
E	5	1 2 3 4 5 6 7 8 9	A
S	6	1 2 3 4 5 6 7 8 9	S
T	7	1 2 3 4 5 6 7 8 9	T
	8	1 2 3 4 5 6 7 8 9	
	9	1 2 3 4 5 6 7 8 9	
	10	1 2 3 4 5 6 7 8 9	

SOUTH

PLAN FOR EXPERIMENTS

Row No.	Material used	Concentration	Number of applications per year	Date of Application	
				Spring	Fall
1	Oil No. 1 (Lubricating oil)	1%	one	May	None
2	Same	1%	two	May	October
3	Oil No. 2 (White Oil)	1%	one	May	None
4	Same	1%	two	May	October
5	Lime sulfur solution	1-50	one	May	
5	Fumigation		one	None	Fall*
6	Check		No treatment		
7	Oil No. 1	2%	one	May	None
8	Same	2%	two	May	None
9	Oil No. 2	2%	one	May	None
10	Same	2%	two	May	October

*Never given.

ANALYSES OF OILS USED

	Oil No. 1 (Lubricating Oil)	Oil No. 2 (White Oil)
Color	Straw	Colorless
Density at 20° C	.882	.852
Flash Point	330° F	365° F
Fire Point	365° F	410° F
Volatility (4 hrs. at 105° C)	1.16%	0.3%
Saybolt viscosity at 10° F	80 sec	95 sec.
Unsulfonated residue	67.6%	96%

Both oils are solid at -5° C. Oil No. 1 is from a paraffin or mixed base crude.

The emulsions were made up fresh at the time of each application. The regular government formula was used. It follows:

Oil	2 gallons
Water	1 gallon
Caustic Potash	
Fish oil Soap	2 pounds

All the materials were put together into a bucket and pumped twice with a bucket pump. The applications were usually made either in late May or early June after the fruit was well set and about three-fourths inch in diameter. In 1927 and 1928 the spraying was done with a barrel pump using a spray rod. There was no spraying done in 1929 because the excitement created by the Mediterranean fruit fly made us forget to do the work. In 1930 and 1931 the materials were applied with a small power outfit, using a spray gun instead of a rod. There was no record of fruit for 1929.

The trees were fertilized and cultivated in about the same manner as commercial properties.

The rate of growth was determined by measuring the diameter of the trunk, about six inches from the ground, twice each year. The height and spread were also measured. The table on page 113 gives the average measurements for each row or treatment for four years, there being no records for 1929.

There does not appear to be any difference in the rate of growth of the trees in the respective plots or treatments.

In 1931 it was observed that the check, Row 6, was located in a slight depression and therefore the conditions of growth might not be entirely representative of those to which the other rows were subjected. Another row at right angles to Row 6 was left unsprayed as a further check. This consisted of Trees 6 in all sprayed rows. There are now two check rows, both in about the center of the grove, one extending from north to south, and one from east to west. The growth measurements of the trees in unsprayed rows and those of trees in adjoining sprayed rows are given in the following table.

TABLE GIVING THE GROWTH MEASUREMENTS OF SPRAYED AND UNSPRAYED TREES
1931

All rows Trees	No. trees in test	Aver. diam. in inches	Aver. height in feet	Average spread in feet
Sprayed				
5	9	3.72	8.66	7.83
7	8	3.53	8.06	7.68
Weighted Average	17	3.63	8.36	7.75
Unsprayed				
Trees 6 - Check	9	3.75	8.22	8.16
Row 6 - Check	7	3.67	8.50	7.92
	16	3.71	8.34	8.06

SUMMARY OF MEASUREMENTS, PARSON BROWNS, COUNTY FARM, OIL PLOTS

	Plot Treatment	1927						1928						1930						1931			
		Spring			Fall			Spring			Fall			Spring			Fall			Spring	Fall		
		D in.	H in.	S in.	D in.	H in.	S in.	D in.	H in.	S in.	D in.	H in.	S in.	D in.	H in.	S in.	D in.	H in.	S in.		D in.	H in.	S in.
1	1% Oil No. 1 once	0.58	17.5	10	0.74	23.3	20.5	1.02	31.3	31.4	1.43	43.8	43.2	2.73	62.1	59.1	2.83	71.1	71.9		3.46	8.0	7.8
2	1% Oil No. 1 twice	0.60	21.4	8.2	0.78	26.1	22.2	1.13	34.5	31.1	1.43	46.2	39.6	2.30	62.8	53.4	2.83	68.5	65.8		3.44	8.0	7.6
3	1% Oil No. 2 once	0.56	17.16	7.67	0.72	20.5	13.2	0.97	32.3	26.9	1.40	39.6	34.8	2.15	58.8	49.8	2.67	66.3	67		3.26	8.5	7.7
4	1% Oil No. 2 twice	0.59	17.11	8.2	0.75	24.2	18.4	1.10	36.8	32.7	1.62	56.4	42.6	2.64	69.0	69.9	3.26	79.3	79.6		3.74	8.2	7.9
5	Lime sulfur 1-50 once	0.56	16.6	12.6	0.67	23.4	16.5	0.72	28.1	20.9	1.20	44.0	27.6	2.03	56.8	54.0	2.63	68.2	61.7		3.18	7.7	7.2
6	Check	0.55	19.0	10.6	0.75	23.3	23.4	1.02	31.0	30.5	1.40	47.2	38.4	2.28	54.8	59.9	2.74	64.1	64.3		3.66	8.5	7.9
7	2% Oil No. 1 once	0.53	18.9	10.9	0.75	24.1	25.3	1.10	36.5	31.2	1.39	45.7	32.2	2.44	57.4	65.1	3.0	68.5	66.3		3.81	8.0	7.1
8	2% Oil No. 1 twice	0.53	20.3	12.0	0.77	27.7	25.5	1.13	35.9	37.3	1.56	46.6	43.3	2.31	63.6	67.8	2.95	70.3	67.7		3.62	8.4	7.6
9	2% Oil No. 2 once	0.56	20.2	9.8	0.83	24.6	27.7	1.23	38.7	39.8		50.0	44.6	2.77	66.0	70.3	3.25	78.0	76.8		3.85	8.1	7.7
10	2% Oil No. 2 twice	0.58	24.8	14.0	0.87	29.4	29.0	1.22	40.7	36.3	1.75	52.6	47.2	2.72	68.4	68.9	3.26	79.5	73.1		3.93	8.2	7.8

D—Diameter in inches. H—Height in feet or inches. S—Spread in feet or inches.

In these experiments there appears to be little or no difference in the average height or spread of the sprayed and unsprayed trees. There does seem to be a slight difference in the average diameters in favor of the unsprayed trees. However, there is a greater difference between the two rows of Trees 5 and 7 than there is between the sprayed and unsprayed trees.

The results of the effect of the oil sprays on the fruit are inadequate for even a preliminary report. The results of 1930 were entirely contrary to those of 1931, and the results of 1931 are not consistent as a whole. It was thought advisable to extend these tests over a longer period of time before reporting on them. The results of the effect of the oil sprays on the solids and acids will also be reported on after they have been extended over a longer period of time.

These experiments and the successful use of oil sprays in Florida for over twenty-five years indicate the citrus grower need not fear any injurious results if the material is applied following approved recommendations. It should always be borne in mind that these sprays are applied to kill insects and should never be applied for general purposes.

Mr. Edsall: Did you check the quality of the fruit as to any burning?

Mr. Yothers: We didn't have any of the condition that we call burning.

Mr. Edsall: Did you get shadowing?

Mr. Yothers: Yes, we got shadowing, but it practically all disappeared.

Mr. Edsall: Was there any difference in the strength of the solution, one and two per cent?

Mr. Yothers: Well, I don't know. I don't think so. This 1931 crop was so erratic, I couldn't say. The greatest difficulty was that the fruit sprayed with the white oils in the fall, either two per cent once or two per cent twice were green. It made them continue green in color and I have the analysis of the fruit on all the plots for four or five different times, and I don't know what to make of it, because the results of 1931 and 1930 contradict each other, and the results contradict the results McBride and I obtained seven or eight years ago. We found any oil put on trees would delay the maturity, but it looks from the results of these little tests here, that I can prove the oil sprays increase the maturity. It's rather bewildering, but as I say the worst drawback was the green color of the fruit, followed by those excessive applications of white oil.

Mr. Edsall: Was any of the fruit colored in the coloring rooms?

Mr. Yothers: I turned the fruit to Mr. Winston; he colored it, and he has all those figures.

Mr. Edsall: You don't know the effects of the different oils on the coloring?

Mr. Yothers: I would rather not talk about somebody else's affairs, but Plot 4 and Plots 9 and 10 were very difficult to color, especially Plot 10, that received the tremendous amount of white oil. Some day we will have these things straightened out better than we have now. At least, I hope so.

Member: Do I understand that although the coloring was delayed, the quality of the fruit was practically the same?

Mr. Yothers: The coloring was delayed, but I am not willing to admit the quality of the fruit was interfered with.

Member: You found the quality of the fruit—the green fruit—just about the same as in the better colored?

Mr. Yothers: It was coarser.

Dr Wilmon Newell: Before I present a few remarks that I have on the subject of The Basis of Plant Quarantines, I wish to say that the Experiment Station is making an effort to accumulate a very complete collection of works and papers dealing with citrus culture and matters of interest to the citrus growers in Florida, and particularly those things which deal with the earlier history of the citrus industry.

Mrs. Cressy, Librarian at the Experiment Station, has been able to make remarkable progress in that respect, which is available for your use, but there are some things rather difficult to get, and if any member of the Society knows where any of these things can be secured, and will help us to secure them, either by gift or purchase, we will greatly appreciate it.

We are particularly in need of any copies of the Florida Agriculturist or Florida Dispatch publications for a good many years, going to complete the files.

There are two publications, on Florida Orange Culture, one by A. H. Manville, published in Jacksonville in 1883, and the other by T. W. Moore, Treatise of Orange Culture in Florida, published in 1877, which we will appreciate your giving us any help you can toward locating them.

THE BASIS OF PLANT QUARANTINES

Wilmon Newell, Plant Commissioner, State Plant Board, Gainesville

For sixteen years the horticulturists of Florida have had more or less contact with plant quarantines; for the most part, quarantines promulgated and enforced for their special benefit and protection. Only once during that time have they experienced material interference with their operations due to a quarantine upon their products for the protection of others and that was during the brief but successful campaign against the Mediterranean fruit fly.

We believe that it can be clearly shown that the quarantines enforced by your State Plant Board, both interstate and intrastate, have been efficiently administered and have been instrumental in protecting your industries against new pests and, consequently, against loss.

Despite this fact, there are some who have not clearly recognized the place which a quarantine properly has in horticultural advancement on the one hand, or the restrictions in its application on the other.

A fundamental principle which must always be recognized is that a quarantine must do more good than harm. Unless the protection which the quarantine affords is greater by far in dollars and cents than its cost of enforcement and its interruption of normal trade and commerce, it is untenable.

Another basic principle is that quarantines cannot be made use of for the purpose of reducing or eliminating commercial competition or interfering with interstate commerce—of building up trade barriers. The law is clear and specific with respect to this. Therefore, a plant quarantine can be enforced only for the protection of an agricultural industry against seriously injurious pests or plant diseases.

A recent experience has brought to light the interesting fact that there are a few citrus growers and others in Florida who actually believe that the State Plant Board can maintain a quarantine for the sole purpose of protecting citrus markets in Florida against competition from California citrus fruit.

This attitude was evidenced following the announcement by the State Plant Board a few weeks ago that, after an exhaustive investigation, it had modified its embargo against California lemons and oranges to permit of shipment of these fruits into Florida under certain safeguards. As the history of this embargo and its modification illustrates the point we are trying to make, perhaps a discussion of it will prove of interest.

Florida's quarantine against California citrus fruits was placed on August 9, 1915, as a protection against the possibility of introduction into Florida of the brown rot of lemons and oranges.

Since 1915, substantial additions have been made to the knowledge concerning this disease: for example citrus may be freed of all spores of the disease which may occur on the surface of the fruit by immersion in a hot bath of 115 degrees Fahrenheit for two minutes. Much progress has also been made in the citrus packing houses of California in the improvement in sanitary methods of handling and packing the fruit. It is believed that the precautions under which California lemons and oranges will be shipped into Florida under the present arrangement are such as to reduce practically to the vanishing point any danger of their carrying brown rot infection.

Bearing in mind that a plant quarantine can be maintained only on the basis of real need for protection against an insect or disease and that it must satisfy that need in order to be valid, there remained, therefore, no sound basis upon which this embargo against California citrus fruit could be continued. The State Plant Board could not, even if it so elected, maintain a quarantine on the products of another state for the purpose of reducing competition.

A few individuals criticized the Board's action in repealing this embargo and substituting a restrictive quarantine, under which California-grown lemons throughout the year and oranges picked between May 1 and October 1, may be brought into Florida under precautions which eliminate the brown rot risk.

Any queston as to what effect, if any, the Board's action may have upon the marketing of Florida's citrus crop is not germane. The cold fact is that the Florida State Plant Board cannot itself violate the law for the purpose of creating a market monopoly for Florida producers. Parenthetically, it may be stated that the Board and most growers and handlers hold the opinion that the shipment into Florida of California lemons throughout the year and of California oranges during the summer months will not materially affect, one way or another, the market for Florida citrus fruits.

In taking this action, the Board acted in accordance with the law and the facts. It did not ask California whether she would reciprocate by taking off her quarantine against Florida citrus

fruits. The Board did no bargaining, for plant quarantines cannot be perverted by making them the subjects of trading for commercial advantage.

Certain insects and diseases, which are not known to occur in California, have heretofore occurred in Florida, and we assume, always, that California maintains a quarantine against our fruit only for the purpose of protecting her industry against these insects and diseases. If and when conditions are such in Florida as to make it apparent to the California authorities that her quarantines are not justified, then and in that event they will doubtless be modified or repealed.

A clear recognition of the fact that plant quarantines can be used only for protection against plant pests, and then only when the economic benefits of the protection are on the right side of the ledger, will do much to clear away confusion on these issues and will make for even more efficient and valuable results from quarantines when it is necessary to use them.

In conclusion, it should be pointed out that quarantine enforcement officials throughout the country have adopted as a fixed policy: (a) the discontinuance of quarantines when they have served their purpose; (b) the modification of quarantines as rapidly as improvement in conditions justifies such action; and (c) abstention from placing quarantines except as a last resort: all to the end that they shall not interfere with trade and commerce unnecessarily, and that profits and prosperity may be enhanced rather than retarded.

L. B. Skinner: I would like to ask Dr. Newell if he thinks the quarantine will ever be lifted on Florida fruit going into California?

Dr. Newell: When Florida has properly put her house in order, Mr. Skinner. We have had citrus canker in this State, the Mediterranean Fruit Fly and a number of insect pests in this State which they have never had, and when Florida can show a clean record, which will convince the California authorities that they can safely admit fruits into California without risking their industry, I firmly believe our fruit will go into that State.

Mr. Skinner: Do you think the same thing maintains in Texas?

Dr. Newell: It is going into Texas now, north of the Southern Pacific Line.

Mr. Skinner: How about south of the Southern Pacific Line?

Dr. Newell: I think that would be true.

CITRUS INSECT CONTROL

J. R. Watson, Gainesville

The topic assigned to me is rather inclusive to be covered in the few minutes at my disposal. I will confine myself to some remarks concerning the general situation as regard some insects in citrus groves at the present time, and a very preliminary report on work on citrus insects which is now in progress chiefly at the Lake Alfred Station under the charge of Mr. Thompson.

As you all know, this has been a very unusual winter—warm and dry. In regard to temperature, I will give you the records for Gainesville. The conditions represented here, however, were statewide and will apply to the entire citrus belt within a few degrees. The mean temperature for November was 5.4° above normal. For December, 10.8°. For January, 7.2°. For February, 11°. For March, 1.3° above normal. The average temperature for these five months, November to March inclusive, was 66.7°. This is only 2.6° cooler than the normal temperature for April and 3° warmer than the normal temperatures for March. In other words, we had early April weather throughout the entire winter. Not only was the winter very warm but it was very dry. The precipitation data, of course, will vary in different parts of the state, but the drouth was pronounced over most of the citrus belt—less so, perhaps, on the lower East Coast. In spite of

the drouth, however, we had many foggy mornings, particularly during January and February. We will refer to this again later. This April weather in the middle of the winter naturally resulted in the appearance of many insects whose activities are usually not much noticed until April. I have been asked many times what the effect of this early starting of these insects may have on their abundance later in the season. Many people have expressed the feeling that because these insects got an early start that they are going to be abnormally abundant and harder to control during the remainder of the season. In many cases citrus insects did get an early start. There were more mealy-bugs and red spiders in evidence in February than we remember ever to have seen before. Rust mites were not abnormally abundant but were considerably in evidence. There were a good many scale crawlers, both the purple and the Florida red.

But it is important to note that the predators and parasites also got an early start, ladybeetles and syrphus fly larvae were much in evidence in colonies of aphids. But perhaps most noticeable in this connection was the growth of the entomogenous fungi during the winter. It is not unusual for the scale fungi, such as the red-headed scale fungus, the white-headed scale fungus and the black scale fungus to make more or less growth during the winter, but this winter there was a marked activity by both the red aschersonia and the brown fungus. That these entomogenous fungi should have developed in such a dry season is very instructive. We have mentioned above the fact that the winter was characterized by many foggy mornings. It is undoubtedly these foggy mornings, together with the abnormal high temperatures, which were responsible for the growth of these entomogenous fungi. In other words, we have been taught this winter that it is not the heavy rains of the summer that promote the growth of these fungi so much as it is the high humidity.

The behavior of the green citrus aphis has been very unusual this winter. Ordinarily we have considered that after the middle of March it was hardly worthwhile under normal grove conditions to spend any money fighting aphids. By that time the growth has usually commenced to harden up and the young fruit is sufficiently developed to withstand attacks of the aphids. But this year because of the drouth conditions, as you all know, the spring flush of growth has been very prolonged and the main flush very late. Indeed, in many sections there was more bloom in citrus groves last week than in any previous week, and more aphids. Many growers found it necessary to dust or spray their groves for aphids a month later than we ordinarily consider the last date necessary. Aphids did not increase very rapidly during January and February in spite of the high temperatures. This was due to two causes: In the first place, the lack of succulent food. What new growth did come out seemed to be too dry and unattractive to serve well as food for aphids. This was shown by the fact that a considerable portion of the aphids developed wings on apparently very young foliage. The formation of wings by the citrus aphis is always a sure indication that the food plant is becoming less suitable for their development. A second cause which kept the aphids down during January and February was the fungus disease *Empusa*. It was much in evidence and quite effective during those months. This again was undoubtedly the result of the foggy mornings. During the latter part of March and the first half of April these fogs have not been so common, with the result that we had less control of the *Empusa*, and a marked rise in the number of aphids during March and April.

Two points in regard to the control of aphids. As has been stated many times before, by all means the most effective and thorough means of controlling aphids on young trees is by dusting under tents; and on old trees, by dusting the grove with a power duster, providing a time can be found when there is no wind and the temperature is not too cold—i. e. below 60°. The results this past year fully corroborate these previous conclusions. It has been our experience heretofore that a 3% nicotine sulphate lime-dust was necessary to get a good kill of aphids, but this year we have seen some very thorough kills with a 2% dust applied by dusting machines which are equipped so that the dusts can be mixed in

the hopper. With these machines the kill has been fully as good as with a 3% dust which is made in a barrel and then has to be transferred to a duster, or fully as good as the commercial samples of 3% dust. In other words it looks as if fully one-third of the nicotine is lost in transferring from the barrel where it is mixed to the hopper of the duster; or in the case of dust which is purchased, two such transfers are necessary. Practically, this means, of course, that this transfer should be as rapid as possible with as little exposure of the dust to the air as possible. However, there is another factor which may account for the good kill with a 2% dust when mixed in the machine itself, i. e., that the mixture gets hot and this high temperature probably results in rapid liberation of the nicotine. We do not want to act as sales agents for any particular make of duster but feel it to be our duty to call the attention of citrus growers to this very important consideration in buying a duster which they may want to use in combatting the citrus aphid. As during previous years a 2% dust of Black leaf 50 has also given equally as good results as a 3% dust of Black leaf 40. This has been found to be true not only in the case of the citrus aphids but Mr. Goff, working on the melon aphis on watermelons, obtained the same results; i. e., a 2% dust of Black leaf 50 is as effective as a 3% dust of Black leaf 40, and appreciably cheaper.

We still find many growers when dusting or spraying for aphids applying the dust or spray too late. Growth which has commenced to reach maturity is not worthwhile to dust—growth which is nearly full-grown. You may kill the aphids all right but they would have left such growth in a few days anyhow and the damage has largely been done. The circumstances under which aphids do most damage is when growth is very young and small, as you see from this specimen, just mere growing points or projections from the stems, hardly differentiated into leaves and stems as yet. A single winged aphid alighting on such growth and starting reproduction at their usual rate of six young a day, can easily prevent the development of such a sprout.

Mr. Thompson has been carrying on at Lake Alfred and other parts of the citrus belt some very interesting work on the effect of lime-sulfur solution on the crawlers of scale insects, particularly the crawlers of purple scale. Tests on a small scale showed that scale crawlers and the first anchored instar of the purple scale will be killed by a lime-sulfur spray, 1-40. Following this hint some tests were made in several groves last summer looking toward the possibility of holding the purple scale in check by frequent applications of lime-sulfur. This work must be carried on several seasons before we can make any recommendations as to its practicability but we feel that the growers should know that a spray of lime-sulfur applied, for instance, for rust mites, will kill very young scales and will have an appreciable effect in preventing an outbreak. This point might well be taken into consideration when a grower is weighing the advantages and disadvantages of spraying with lime-sulfur for rust mites as compared with dusting with sulfur. In groves sprayed three or four times with lime-sulfur at intervals of a month or six weeks we were able last season to hold the purple scale in chcek. However, these sprayings were timed to catch the largest number of crawlers, i. e., a close watch was kept on the purple scale for crawlers, which was early in May. In some plots the spray was applied once a month and in others once every six weeks or two months between sprays. In some of these sprays an excess of lime was added and on some trees lime alone was sprayed on at the rate of 10 to 20 pounds per 100 gallons of water. On these trees sprayed with lime alone there was in every case a very marked increase in the amount of purple scale.

Mr. Thompson is carrying on at Lake Alfred some experiments on poisoning ants in citrus groves. This is done with the idea of seeing what effect, if any, they have on mealybugs and cottony cushiony scale. Also with the idea of perhaps aiding in the establishment of the Cryptolameus* and *Leis* ladybeetles in these groves. So far the chief result has been much satisfaction expressed by those who picked the fruit or worked in this section of the grove.

Mr. Waldron: How are those ants exterminated?

Prof. Watson: By the use of regular sodium arsenate, and sugar bait is used for the control of Argentine ants.

L. B. Skinner: How about that?

Prof. Watson: I said Sodium arsenate and sugar, as described in Bulletin 233, put in paper cups and nailed to the tree.

L. B. Skinner: How much did you put in?

Prof. Watson: Sodium arsenate ¼ of 1% in sugar solution. If you make it too strong the ants won't touch it.

Mr. Bowman: I believe you mentioned an increase in scale in cases of excess lime. Will you give the reasoning?

Prof. Watson: I believe the pathologists are recognizing that calcium hydroxide is a fungicide, and it may have been due to the calcium hydroxide on the fungi later in the season. There was rather a marked rise in fungi, but the first effect was to check the development of the fungi. We have it on excessive scale, and in every case we could see a rise of the fungi.

Mr. Bowman: Was there any benefits noticeable from the use of excess of lime?

Prof. Watson: We made no rigid tests, but from a superficial examination I couldn't see any.

Mr. Edsall: Does anybody know whether additional lime has any effect on the control of melanose?

Prof. Watson: Is Mr. H. E. Stevens present? He or anybody else that knows about that?

Prof. DeBusk: We had a few trees, and I don't see how the lime could have any effect on the melanose fungus; it's imbedded in dead bark and you can't get at it with a strong fungicide until it is forced out. The only protection we seem to get from the application of the Bordeaux mixture is from covering the surface of the young fruit and giving it protection in that way against the infection by the melanose fungus.

NON-ARSENICAL STOMACH POISONS FOR GRASSHOPPER AND BEETLE CONTROL

W. L. Thompson, Lake Alfred

Grasshoppers, as a rule, are not a serious pest of citrus trees, especially trees over three or four years old. During the fall of 1931 they did severe damage in some orange groves in the central part of the State. Due to recent legislation prohibiting the use of arsenicals on citrus groves, except by special permission, it was necessary to make some tests of non-arsenical stomach poisons to control these pests.

The grasshopper doing the most damage was the "Bird Grasshopper," *Schistocerca americana.* It is rather long and slender, a powerful flier, and very active, especially on sunny days. It is evidently a sun-loving insect, as the trees were most severely damaged on the sunny side.

The grasshoppers used for the following experiments were collected from one of the infested groves. Wire screen cages 11"x14"x18" were used in the dusting, spraying, and a few of the bait tests. The majority of bait tests were made in cages of the above size but having no bottoms. In each test potted citrus plants were put into the cages, or the bottomless cages were placed over young citrus trees in the nursery. In almost every case the tests were started the day after the grasshoppers were collected.

Kalo, a material made up of 96 per cent sodium silicofluoride, gave very good results when used in a bran mash. Kalo used at the rate of 3 pounds to 50 pounds of bran, 1 gallon of syrup, and approximately 10 grapefruit gave a 100 per cent kill in two to three days. A wire screen cage six feet square and six feet high was placed over a three year old orange tree and the above bait applied on the tree and ground. There were 80 grasshoppers used in this experiment.

In three days 97.5 per cent of the grasshoppers were dead. The results of this experiment seemed to justify a field test.

Test 52—*Field Test.*

In the field test the following formula was used:

Kalo 3 pounds, Bran 50 pounds, 1 gallon syrup, 15 grapefruit, and water enough to make a stiff mash. This material was applied to four acres of Temple oranges about eight years old. Approximately two large handfuls of bait was applied on and around the east and south sides of each tree, since the most damage was done there. Most of the grass and weeds had been killed by cultivation. This bait was applied between six and seven o'clock in the evening.

Before application of the bait an approximate average of thirteen grasshoppers would fly from the trees when the foliage was disturbed. After four and one-half days, observations were made to determine the effect of the bait. An approximate average of two grasshoppers per tree were observed, or about an eighty-four per cent kill. Many trees had no grasshoppers on them, the number ranging from zero to five per tree. A few dead hoppers were found under the trees, but due to the fact that so much dead grass was on the ground it was difficult to find them.

The far side of the same grove was used as a check, ten rows removed from the treated section. There was no decrease in the number of grasshoppers in this section of the grove during the four and one-half days.

The above observation were made from one to two-thirty o'clock in the afternoon when the grasshoppers were very active.

Sodium fluoride, used at the rate of 1 pound to 20 pounds of bran and 2 quarts of syrup, gave a 100 per cent kill in three to four days. This combination gave better results than using 2 pounds of sodium fluoride to 20 pounds of bran, since a kill of only 90 per cent was obtained after six days. It is quite probable that 2 pounds of sodium fluoride per 20 pounds of bran is distasteful to the grasshoppers. Sodium fluoride, mixed with oat-meal and syrup, gave only a 40 per cent kill in six days. Sodium fluoride, as well as the Kalo, should be sifted through a fine screen before it is mixed with the bran as both of these materials are more or less lumpy.

Kalite, a dust containing 18 per cent sodium silicofluoride, gave a kill of 100 per cent in six days when the plants and grasshoppers were both dusted, but when only the plants were dusted, the kill was but 55 per cent in six and one-half days and ninety-nine per cent of the leaves were eaten off the plant. Kalite did not stick well on the citrus leaves but in a mixture of 3 parts of Kalite to 1 part of Talc, the adhesive quality seemed to be improved. Two different tests were made by placing five grasshoppers under a small wire screen and dusting Kalite over them and on the boards where they had to crawl. No food was under these screens. After 48 hours all the dusted grasshoppers were dead and in the checks, none.

It is quite evident from these results that this material, applied as a dust, should come in contact with the grasshoppers to insure a good kill. In cleaning their appendages they no doubt swallowed some of the poison which is probably the reason for the high per cent of kill when both grasshoppers and plants were dusted. It might be well to note here that when rose chafers were dusted with Kalite, the kill was 40 per cent higher when both the beetles and plants were dusted than when the plants alone were dusted.

Although it has been stated that these grasshoppers are very active, they are rather quiet until eight or nine o'clock in the morning, especially during the fall and winter months, and it is doubtful that the dusting machine would disturb them if the dust were applied in the early morning. During the summer they are no doubt active earlier in the day.

Kaolith, made up of 94.26 per cent sodium aluminum fluoride, applied as a spray, gave only a 20 per cent kill in six days, and approximately ninety-nine per cent of the leaves of the plant were eaten. The adhesive quality of this material is also very poor on citrus. By adding 1 per cent of Penetrol, a sulfonated oil, a kill of 70 per cent was obtained in five and one-half days and 80 per cent in eight and one-half days.

Copper carbonate baits and sprays only gave fair results. Copper carbonate at the rate of 16 pounds per 200 gallons of water, 50 pounds of sugar, and 10 gallons of syrup gave only a 36 per cent kill in seven days. When the amount of copper carbonate was raised to 25 pounds with the same amount of the above ingredients, a kill of 80 per cent was obtained in five days. After six and one-half days approximately fifty per cent of the leaves of the plants had been eaten and on the checks, ninety-nine per cent. Copper carbonate in a bran mash was tested in amounts from 2 pounds to 9 pounds to 50 pounds of bran with syrup and grapefruit. The syrup was increased from four quarts to six quarts to make the bait more attractive, but the kill was not increased. In one test copper carbonate, used at the rate of 5 pounds to 20 pounds of bran with 2½ quarts of syrup, gave a 10 per cent kill in five days.

A 5-5-50 Bordeaux mixture gave a 60 per cent kill in five days and 80 per cent in ten days. A combination of a 5-5-50 Bordeaux mixture and arsenate of lead at the rate of 4 pounds to 100 gallons of water gave only a 64 per cent kill in seven days.

Neither bichloride of mercury nor strychnine gave any results as a poison for grasshoppers.

Out of 200 grasshoppers that were not exposed to poison, only six parasites were observed. The parasites were tachinid flies.

ROSE CHAFERS

(*Macrodactylus angustatus*)

In February our attention was called to a light infestation of rose chafers in a grove at Bradenton. These beetles were eating the buds, blossoms, and young fruit of orange trees in one section of the grove. A number of them were collected and a few tests were made to determine the effect of the silicofluorides as a control measure.

It has been mentioned in a previous statement that Kalite did not stick satisfactorily to citrus leaves when applied as a dust. In order to improve the sticking quality of this dust, Penetrol was added. The Kalite was spread out on a piece of paper where Penetrol, a sulfonated, oxidized oil derivative was added by spraying it over the dust in a fine mist with a small spray gun. The dust was then thoroughly agitated. This process was repeated several times. The mixture was applied with a small dust gun as the beetles were in screen cages, the same cages that were used in the grasshopper experiments. Orange twigs with blossoms on them were put into bottles of water for food for the beetles. In the test where the rose chafers and blossoms were both dusted, a 100 per cent kill was obtained in two days; where the blossoms only were dusted the kill was 50 per cent in three days, which was the same mortality as in the check cages. Kalite, without the addition of Penetrol, dusted on beetles and blossoms gave a 60 per cent kill in two days, 80 per cent in three days, and a 60 per cent kill when the blossoms alone were treated. It is quite possible that the Kalite and Penetrol mixture acted as a repellent to the bettles, since they were usually on the sides of the cage when observations were made. The treated blossoms were not chewed by the beetles, but in the check they were.

Although the speaker cannot give direct reference at this time as to the use of a light oil in a dust to increase the adhesive qualities, it has been used at the rate of four to six pounds per 100 pounds of lime-arsenate of lead dust in codling moth control.

One series of tests was made by placing the bettles under a small screen and no food supplied. One lot of bettles and the area where they had to crawl about was dusted with the Kalite-Penetrol combination. The beetles were all dead in 48 hours. Another lot was dusted and placed under the screen with no dust under it and 80 per cent were dead within the 48 hour period; in the check 20 per cent were dead. This again demonstrated the value of hitting the insects with this material.

Kaolith, applied as a spray, at the rate of 6 pounds per 100 gallons of water and one gallon of syrup gave a 90 per cent kill in three days when both the beetles and blossoms were sprayed, and 80 per cent when the blossoms alone were treated. In the check, there was a mortality of 70 per cent so that very little can be learned from

this experiment as to the real value of this material as a control for these beetles.

In conclusion, sodium fluoride and Kalo used in a bran mash, gave the most promising results and were the most economical in controlling grasshoppers. Both of these materials gave results comparable to a Paris green bran mash in like amounts. Kalite, used as a dust, gave fair results, especially when it came in contact with the insects. Copper carbonate gave only fair results, unless used in rather large amounts. None of the spray combinations was very satisfactory.

So few tests were made with the rose chafer that no definite recommendation can be made at

ARTIFICIAL CONTROL OF GRASSHOPPERS (SCHISTOCERCA AMERICANA)

Test No.	Applications	Number Specimens	Percent Dead	Days	Percent Dead	Days	Percent Dead	Days	Percent Dead	Days
	Dusts									
1.	Kalite—Plants and grasshoppers dusted	20	80	2½	84	3½	84.6	4½	100	6½
2.	Kalite—Plants and grasshoppers dusted	15	86	2½	86.6	3½	86.6	5½	100	6
3.	Kalite—Plants and grasshoppers dusted	20	60	2½	80	3½	100	4½		
4.	Kalite—Plants dusted only	20	5	2½	20	3½	40	4½	55	6½
5	Kalite, 3 parts, Talc, 1 part. Plants and grasshoppers dusted	19	84.6	2½	84.6	3½	90	4½	90	6½
6	Kalite, 3 parts Talc, 1 part. Plants and grasshoppers dusted	20	85	2½	95	3½	100	5½		
7.	Check for tests 1, 2 and 5	20	5	2½	5	3½	10	4½	60	6½
8.	Check for tests 3, 4 and 6	20	5	2½	25	4½			35	6½
	Sprays									
9.	Kaolith—4 lbs. per 100 gallons	20	10	2	20	4			20	6
10.	Kaolith—4 lbs. per 100 gallons plus Penetrol 4%	20	60	2½	65	3½	70	5½	80	8½
11.	Arsenate of Lead, 2 lbs per 100 gallons	20	10	2½	30	4½	65	5½	85	10
*12.	Arsenate of Lead, 2 lbs. per 100 gallons	80	13.7	2½	22.5	4½	27.5	5½	37.5	12
13.	Arsenate of Lead, 4 lbs per 100 gallons, plus Bordeaux 5-5-50	25	16	2			52	5	64	7
14.	Bordeaux Mixtxure 5-5-50	20	15	2½	60	4½	60.5	5½	80	10
15.	Copper carbonate 16 lbs, Sugar 50 lbs, Syrup 10 gal, Water, 200 gal.	25	4	2½	1		24	5	36	7
16.	Copper carbonate 25 lbs, Sugar 50 lbs, Syrup 10 gal, Water 200 gal.	25	36	2½			80	5	100	7
17.	Check for test 9	20	5	2½	5	3½	10	4½	60	6½
18.	Check for test 10, 11, 12 and 14	20	5	2½	25	4½	35	6½	85	10
19.	Check for test 13, 15, and 16	25	0	2	4	3½	8	4½	32	7
	Baits									
20.	Sodium fluoride 2 lbs., Oat-meal 20 lbs., 4 Lemons	20	5	2	5	3	10	4	40	6
21.	Sodium fluoride 2 lbs., Bran 20 lbs., Syrup 2 qts., 4 Lemons	20	35	2½	85	3½	85	4½	90	6½
22.	Sodium fluoride 1 lb., Bran 20 lbs., Syrup 2 qts., 5 Grapefruit	20	85	2½	95	3½	100	4½		
23.	Sodium fluoride 2 lbs., Bran 50 lbs., Syrup 1 gal., 15 Grapefruit	25	92	2	100	3				
24.	Paris Green 1 lb., Bran 20 lbs., Syrup 2 qts., 4 Lemons	15	80.9	2	95	3	100	4		
25.	Kalite, 1 part, Bran, 9 parts, Syrup 2 qts., 4 Lemons	20	0	2½	0	3½	10	4½	25	6½
26.	Kalo 2 lbs., Bran 50 lbs., Syrup 1 gal., 10 Grapefruit	25	96	2	100	3				
27.	Kalo 3 lbs., Bran 50 lbs., Syrup 1 gal., 10 Grapefruit	25	100	2						
28.	Kalo 4 lbs., Bran 50 lbs., Syrup 1 gal., 10 Grapefruit	25	96	2	96	3	100	4		
29.	Kalo 3 lbs., Bran 50 lbs., Syrup 1 gal., 10 Grapefruit	25	100	2½						
30.	Kalo 3 lbs., Bran 50 lbs., Syrup 1 gal., 15 Grapefruit	25	96	2	100	3				
*31.	Kalo 3 lbs., Bran 50 lbs., Syrup 1 gal., 15 Grapefruit	80	25	1	50	2	97.5	3		
32.	Strychnine 10 gr., Bran 20 lbs., Syrup 2½ qts., 4 Lemons	25	0	1½	8	4½	12	5½		
33	Bichloride of Mer., 1-200, Bran 20 lbs, Syrup 2½ qts, 4 Lemons	25	4	2	8	5	24	7		
34.	Copper carbonate 5 lbs., Bran 20 lbs., Syrup 2½ qts., 4 Lemons	25	80	3	100	5				
35.	Copper carbonate 3 lbs., Bran 50 lbs., Syrup 4 qts., 10 Lemons	25	20	1½	68	3½	72	4½	76	5½
36.	Copper carbonate 3 lbs., Bran 50 lbs., Syrup 4 qts., 10 Lemons	25	24	1½	52	3½	76	4½	96	5½
37.	Copper carbonate 5 lbs., Bran 50 lbs., Syrup 4 qts., 10 Lemons	25	20	1½	64	3½	80	4½	88	5½
38.	Copper carbonate 6 lbs., Bran 50 lbs., Syrup 5½ qts., 10 Lemons	15	46.6	2	53.3	3	73.3	4	86.6	6
39.	Copper carbonate 7 lbs., Bran 50 lbs., Syrup 5½ qts., 10 Lemons	15	53.3	2	66.6	3	66.6	4	86.6	6
40.	Copper carbonate 8 lbs., Bran 50 lbs., Syrup 5½ qts., 10 Lemons	15	53.3	2	86.6	3	86.6	4	93.3	6
41.	Copper carbonate 9 lbs., Bran 50 lbs., Syrup 5½ lbs., 10 Lemons	15	33.3	2	60.6	3	86.6	4	86.6	6
42.	Copper carbonate 6 lbs., Bran 50 lbs., Syrup 6 qts., 15 Grapefruit	15	33.33	2	53.33	3	80	4	86.6	7
43.	Copper carbonate 7 lbs., Bran 50 lbs., Syrup 6 qts., 15 Grapefruit	15	46.66	2	66.66	3	80	4	80	7
44.	Copper carbonate 8 lbs., Bran 50 lbs., Syrup 6 qts., 15 Grapefruit	15	40	2	66.66	3	73.33	4	93.33	7
45.	Checks for tests 42, 43 and 44	15	6.66	2	13.33	3	20	4	26.66	7
46.	Checks for tests 20, 21, 24 and 25	20	5	2½	5	3½	10	4½	60	6½
47.	Checks for test 22	20	5	2½	25	4½	35	6½	85	10
48.	Checks for tests 23, 26, 27, and 28	25	0	2	4	3				
49.	Checks for tests 29, 33, and 34	25	0	2½	4	3½	8	4½	32	7
50.	Checks for tests 30, 31, 32, 35, 36, and 37	25	0	2½	4	3½	8	4½	12	5½
51.	Checks for tests 38, 39, 40, and 41	30	3.3	2	9	3	15.1	4	24.2	6

*Screen cage, 6 ft. x 6 ft. x 6 ft. over three year old tree.

this time, except that a better kill can be obtained when the insecticide comes in contact with this type of insect. It is also likely that it will seldom be necessary to take control measures against this beetle in the grove, as this is the first instance in Florida it has been reported damaging citrus.

INGREDIENTS OF MATERIALS USED

Kalite	Sodium silicofluoride	18.0%
	Sulfur	19.0%
	Inert ingredients	62.0%
Kaolith	Sodium aluminum fluoride	94.26%
	Inert ingredients	5.24%
Kalo	Sodium silicofluoride	96.0%
	Inert ingredients	4.0%

Sodium fluoride—active ingredients ---- 90-95%
Arsenate of Lead—active ingredients ---- 98%
Copper—active ingredients—Metallic copper 18%

OBSERVATIONS OF TREATED PLANTS EXPOSED TO GRASSHOPPERS

Kalite, ¾, Talc, ¼, dusted on plants and grasshoppers Leaves eaten 5% after 6½ days
Kalite dusted on plants and grasshoppers Leaves eaten 1% after 6½ days
Kalite dusted on plants only ------ Leaves eaten 99% after 6½ days
Kaolith sprayed on plants only ------- Leaves eaten 99% after 6½ days
Lead arsenate, 2 lbs. ------ Leaves eaten 90% after 6½ days
Check ------ Leaves eaten 99% after 6½ days
Strychnine Bran Bait ------- Leaves eaten 99% after 6½ days
Kalo Bran Bait Leaves eaten 1% after 6½ days
Sodium fluoride Bran Bait ------- Leaves eaten 1% after 6½ days
Copper carbonate spray ------ Leaves eaten 50% after 6½ days

The table on page 122 gives in detail the results of the various experiments.

ECONOMIC FACTORS IN CITRUS DISEASE AND INSECT CONTROL

E. F. DeBusk, Gainesville, Fla.

The amount of money spent annually by Florida citrus growers on citrus disease and insect control has been estimated at approximately $2,000,000. Most of this is spent on direct control—spraying and dusting the trees. While there is room for improvement in the application of these direct control measures, and perhaps opportunity for increasing our annual spraying investment at a profit, indirect control measures should receive more attention. The successful and economical control of citrus diseases, and some insect pests, often depends more upon preventive and precautionary measures than upon direct control treatments. Many of our citrus disease troubles could have been avoided by exercising a little more care in selecting the grove site, rootstocks and varieties. But even after the grove is planted certain unfavorable conditions can be modified, bringing about more favorable environmens for growing vigorous trees, trees more resistant to both disease invasion and insect attacks.

I am sometimes reminded that our citrus disease control methods are often too much on the order of taking headache powders for headaches. This is probably due to the fact that it is comparatively easy to demonstrate that a fungus disease can be checked, and often controlled, by spraying the tree with a fungicide. Then, too, there is a peculiar psychology that enters into the situation. People have heard a lot about spraying and some think it is a cure-all for the citrus tree troubles. They hear the spraying machines running in the community and catch the spirit of it, and want to spray. The advertising sells it. I have been called into groves for consulta-

tion and found the trees in a starved run-down condition, and the first thing the new grower wanted to know was what kind of spray to use and when to apply it. When I began to try to teach him that the soil conditions and soil management are the foundation of successful citrus production, the place to begin effective and economical disease control, he seemed inclined to change doctors and get one who prescribed headache powders.

Many of our citrus tree troubles or diseases are due directly or indirectly to soil conditions or soil management methods unfavorable to normal tree growth and fruit production. With this handicap the grower often fails to correct the abnormal conditions showing up in his trees by spraying or applying some other direct treatment, instead of first going back to the soil and making an effort to bring about and maintain a soil condition more favorable to normal tree growth.

What I am trying to say is that we should begin at the foot of the ladder—get down to sound fundamentals in plant growth and fruit production—instead of going to the top of the tree to try to correct a trouble that originates at the other extremity.

MELANOSE

Experience and observation lead to the conclusion that the first thing to do in economical control of the dreaded disease, melanose, is to go to the bottom and remove as far as practicable the indirect causes of the disease. Since dead wood in the tree is the direct source of infection, an effort should be made to find out what is causing the dead wood, and to correct it. Much of the dead wood in our trees is caused by root pruning, the result of deep ploughing, and improper cultivation. A common cause of dead wood is underfertilizing, resulting in weakened trees easily killed back by insects, diseases and low temperature. It must be borne in mind that a hungry tree is a feeble fighter. An inadequate supply of soil moisture during the dry season is the principal cause of dead wood in many of the old groves of the state. There are many conditions and cultural practices that result in dead wood in the trees. One dollar spent in correcting the unfavorable condition or practice that results in dead wood may prove more effective in the control of melanose than five or ten dollars spent on direct control by spraying and pruning.

I think I can make clearer what I am driving at by relating the experience of a certain grower. After fighting melanose for four years and making no progress, he began to take stock. Upon analyzing his grove conditions and practices it was found that he had fallen into a rut and was going around in a vicious circle, so to speak. His records showed that a January freeze had left his grove with much dead wood, and a heavy infecion of melanose followed. He had never used bordeaux mixture in his grove, and had depended very largely upon scale fungi to keep the scale-insects under control. This sudden outbreak of melanose made him frantic and he rushed in and sprayed thoroughly with bordeaux mixture, after a rain had already fallen on the young fruit. Apparently he got very little control of melanose as the fruit had already become infected. The bordeaux killed off his scale fungi completely, the trunk and all parts of the tree above ground having been thoroughly sprayed. Scale-insects soon became very numerous and it was necessary to spray with oil emulsion twice within the first twelve months. This heavy oil spraying, together with the weakened condition of the trees from the freeze, resulted in much dead wood the following spring, in spite of the fact that he kept pruning crews busy pruning out dead wood all the year. He followed the same procedure the second year. It was a dry spring and he got satisfactory control of melanose. The third year he followed the same program, even though he had a light crop of fruit. No profits were coming from the grove, and consequently the melanose spraying was omitted the fourth year. This happened to be a bad melanose year and his losses from the disease were heavy. Dead wood was still forming in the grove, even though he had pruned almost continuously. Some of the fruit showed ammoniation, and he had been persuaded to reduce the ammonia in his fertilizer mixture to two per cent. He had ploughed the grove every fall, and cultivated often over a period of seven months. Very light cover-crops were produced.

When he began to analyze and study his conditions and practices he soon saw that he was on the wrong track for economical control. It was evident that the root-pruning by deep ploughing and excessive cultivation not only contributed largely to the annual crop of dead twigs and branches but was responsible, in a large measure at least, for ammoniation of the fruit. The low nitrogen fertilization resulted in a weakened condition of the trees and rendered them more susceptible to disease and insect attack, and cold injury. This added to the crop of dead wood, and consequently resulted in more melanose. The severe pruning further weakened the trees, increased the amount of dead wood, and only seemed to help defeat the melanose control program.

Attention was then directed toward improving the unfavorable conditions and practices. Deep ploughing was abandoned and two to three shallow cultivations were practiced. This permitted the production of more organic matter through cover-crops, and along with heavier fertilization, resulted in more vigorous trees and the production of less dead wood. This in turn reduced the amount of melanose to the point where it was no longer economical to spray for its control; the scale fungi were soon re-established in the grove, removing the necessity for regular oil spraying; the production cost was reduced and the quality of trees and fruit improved.

It is not my intention to discourage either pruning or spraying for melanose control where the operation is likely to produce results. But I wish to call attention to the fact that the problem is often approached from the wrong angle. More attention should be given to maintaining vigorous trees. The old adage—"A stitch in time saves nine"—applies here, but the stitch must be made at the proper place. Close observation has brought out the fact that severe pruning of weakened trees during the month of July to November often results in an increase of melanose the following spring. It seems that the old dead branches pruned out at that time contain very few, if any, melanose spores and consequently do not constitute a potent source of melanose the following spring. On the other hand, severe pruning is weakening to a tree and is often followed by further dying back of small branches. It is these branches and twig tips that die just prior to the setting of the young fruit that seem to be the most fertile source of melanose infection. The buttons left by the dropping of mature fruit in February and March are usually very productive of melanose spores during April and May following. Pruning for melanose control, to be effective, must consist in removing before the young fruit has set, wood that has been killed during late winter and early spring of the current season. Of course this is often very impracticable. Pruning out wood that has been dead more than five or six months is apparently not resulting in enough control to justify the expense.

If the grower finds that it is not practicable under certain conditions to control melanose by preventing the production of dead wood, the only alternative is to spray. Up to the present time, bordeaux mixture has proven to be the most effective fungicide for melanose control. It is used at a concentraion of 3-3-50 to which oil emulsion is usually added at the rate of 3 to 5 quarts to the 100 gallons of bordeaux, as a spreader and, presumably to aid in scale control. Some prefer to leave out the oil, using casein as a spreader, as it is usually necessary anyway to follow with an oil spray in May or early June to control scale. The effectiveness of bordeaux-oil spray depends upon the quality of material used, and the time and manner of application. A fresh, home-made bordeaux usually gives the best results. In applying the spray, the primary aim should be to cover the young fruit with the fungicide to prevent the spores of the fungus from lodging on the surface of the fruit and causing the blemishes of the disease. This must be done after the fruit has set and before the spores have been carried from the dead wood on to the fruit by rain or heavy dew.

In spraying with bordeaux for melanose control it is desirable to leave the trunk and large limbs of the tree unsprayed, covering only the fruit-bearing surface of the tree. By so doing the scale fungi on the trunk and limbs of the tree will be

preserved and will aid in the control of scale-insects.

OTHER DISEASES

The same fundamental principles hold true in the successful and economical control of withertip, diplodia, gummosis, psorosis, and even foot rot. It seems that diplodia is often disseminated by pruning out small dead and diseased twigs while the disease is active. Every cut leaves an avenue for a new infection, right out among the infected twigs. These small cuts never receive the wound treatment. Until such time as we have more proof that these small dead twigs may become a potent source of melanose infection the second year, it seems that we might as well leave those that cannot be pruned out just before the crop is set until they become sufficiently brittle to be broken out by hand or decay and drop out. This practice does not encourage the spread of diplodia and results in the production of less dead wood over a period of years. Even large dead limbs should not be cut out unless the wounds are to be properly treated. Better to leave them to rot and fall out than to make new wounds and leave them untreated.

GUMMOSIS AND PSOROSIS

Very little is accomplished by direct treatment of gummosis or psorosis unless the soil condition and general grove management are first made more favorable for tree growth. An outbreak of one or both of these diseases is usually preceded by a condition that results in a severe shock to the individual tree. This shock may be the result of drought, water injury, under-fertilizing, low temperature, or other factors. Sometimes the first conspicuous symptom of either of the diseases is an abnormally heavy crop of fruit. Removing some of the fruit in its immature stage may prove to be an aid in checking and controlling the diseases.

FOOT ROT

Soil moisture control and proper fertilizing are important factors in the successful treatment of foot rot. The root system of a tree affected with foot rot is more or less impaired in its functions and may be unable to take up a sufficient amount of water and plant food, under adverse conditions, to sustain top growth and fruiting. Such trees should first have special attention as to moisture supply and available plant food, otherwise dying back at the top will result even before the advanced stage of the disease is reached.

In old seedling groves where foot rot is more or less prevalent, it is a good practice to give the trees a foot bath once a year, using a strong bordeaux mixture (6-9-50). This may be done with a power sprayer or a good barrel sprayer, using a nozzle that will throw a large stream, and sufficient pressure to drive the material well into the ground close up to the crown roots.

Surgical methods are very expensive and often ineffective in controlling foot rot. The root system of trees that have become weakened by foot rot may be greatly strengthened and the trees rejuvenated by banking with the grove soil to a height of 14 to 16 inches above the diseased area. A new root system (natural inarching) may be induced to develop within 3 to 5 years by this method.

DIEBACK

It is of decided economic importance to note that changes in cultural practices are throwing rays of hope on the control of some of our formerly serious citrus diseases, thought to be tied up with complex nutritional disorders. For example, exanthema (dieback) is becoming less prevalent along with the reduction of grove plowing and cultivation, and where a more adequate supply of coarse organic matter is provided. The so called ammoniation of fruit is becoming quite generally recognized as the result of excessive cultivation and under nourishment of trees.

WHITE FLY

The cost of citrus insect control may be greatly reduced by cooperating with nature. It has been actually demonstrated that whitefly can be controlled by spraying the trees at the proper time with cultures of red aschersonia, and by encouraging the development of the brown fungus, at a cost of 15 to 25 per cent of that of controlling the insect by spraying with oil emulsion. The cultures may be applied with the regular grove power

sprayer after it has been thoroughly cleaned. By using double nozzles or brushes and arranging for the operators to ride, two rows may be sprayed with the cultures as rapidly as the machine can be drawn across the grove behind a tractor.

SCALE-INSECTS

The problem of scale control in the bearing grove may be greatly simplified if the grower will only study his conditions and take advantage of the factors in natural control. The first and most important thing in the economical control of scale-insects, as well as most all insects, is to see that the trees are properly nourished. I must repeat: a hungry tree is a feeble fighter. This is true regardless of whether the attack is made by an insect pest or a disease organism.

Feeding citrus trees properly implies more than the application of so many pounds of a certain kind of fertilizer. Soil moisture and organic matter are two of the most important factors in proper tree nutrition. The value of a dense foliage on a citrus tree is recognized as a factor in natural control of insects as well as in the quality of the fruit produced. This quality of foliage can be brought about only by proper tree nutrition. A dense foliage presents a more favorable condition for the development of entomogenous fungi and consequently renders more efficient natural control of scale and whitefly and other insect pests. It affords protection to lady beetles and other predatory insects against birds and other enemies.

A fuller knowledge on the part of the grower as to what is actually taking place from time to time in the insect life on the tree, may enable him to save money on his pest control program. In the development of a purple scale infection in a grove it has been noted that, at first scale-insect develops more rapidly than its parasitic fungi. But later on when the scale infestation has reached the stage of weakening the tree appreciably and attracting the attention of the grower, the scale fungi, if examined, may be found to have developed to the point of placing the scale under control. The grower, in his excitement and anxiety to correct a condition in his trees brought on by the scale infestation, may resort to spraying, after control of the pest has already been accomplished in the natural way. Experiences of this kind suggest the economic importance of closer cooperation with nature in insect pest control in the citrus grove.

The importance of thoroughness in spraying with oil emulsion cannot be over-emphasized. In too many cases the efficiency of an oil spraying, poorly done or applied at the wrong time, is so low that the losses from oil injury to the tree or fruit are greater than that which results from leaving the trees unsprayed. Do the job thoroughly or not at all. Under certain conditions an extra application of nitrogen at the critical time or an application of irrigation water may be used as a substitute for an oil spraying by holding up the resistance of the trees until the parasitic fungi can gain control.

RUST MITE

In economical rust mite control, the advantages of a heavy cover-crop, minimum cultivation, and a dense tree foliage are generally recognized. Any one of these conditions is usually accompanied by less rust mite injury, other conditions being on a comparable basis, than where the conditions do not exist. It seems that any one of the conditions mentioned favors the development of the rust mite fungus, through the influence of a more humid atmosphere produced by moisture given off by the cover-crop and foliage, resulting in more efficient natural control of the pest and consequently the necessity for less spraying or dusting.

Time will not permit continuing the discussion. I want to say in closing that, in our programs of citrus disease and insect control, timeliness is a very important economic factor. More attention should be given to diseases and insects before it is too late for economical control. Prevention should be the watchword. This implies the use of every economic factor in natural and indirect control.

THE TEMPLE ORANGE AND ITS CULTURE

Albert DeVane, Lake Placid

The Temple Orange, as now propagated, came from an original tree growing on the Temple property in Winter Park, and was named after the late William Chase Temple. Another version of the origin of this variety is that the tree or variety is one of the old oranges of Jamaica, trees there bearing fruit almost identical with those which we grow under the name of Temple, with the exception of a weaker color.

With the introduction of the Temple Orange in 1917 through 1922 there were approximately one and a half million trees budded on rough lemon stock. To date there are about one hundred and twenty-five thousand trees in grove form of which only twenty percent are on the rough lemon stock, the balance of the original plantings have been either destroyed or budded to other varieties. The major part of my observations and activities with the Temple Orange have been with trees budded on rough lemon stock. Many of us are acquainted with the success of the Temple on sour orange root and some growers' success of those budded on Cleopatra Mandarin stock. On the other hand it is estimated that sixty-eight percent of the bearing Temple trees of the state are on rough lemon stock. To growers like ourselves, who have 150 acres of Temples in our planting on such stock, these have been until recently a liability rather than an asset. I had a persistent belief that it is possible to produce as good quality fruit of this variety on rough lemon as is grown on sour orange stock. The results of the last two crops seem to justify this belief. The primary undesirable feature of the Temple on rough stock is the tendency to dry at the stem end even long before maturity. My observation and experience with this condition has led me to the belief that this is to be handled through the positive control of the available nitrogen supply throughout the year.

Let me explain more fully my experience regarding what I call the positive control of the avilable nitrogen supply which will entail many methods of fertilization and culture contrary to most practices. The Temple tree is a vigorous grower and will grow the entire year if sufficient plant food is available. The quality and texture of the fruit is moulded in the late summer and fall months. One trouble found in using an organic high in nitrogen during the heavy rains and maximum bacterial activities of summer are the uncontrolable effects of the nitrogen fed to the trees in the period of quality determination of the fruit. It has been my observation that the tree should be given the maximum amount of nitrogen in the spring, pushing the tree and fruit as rapidly as possible in order to produce the large size preferable in the Temple. There is no danger in making the fruit coarse with the heavy application of nitrogen in the spring and, generally speaking, the size of the fruit is determined by the growth made during the spring and until the latter part of May. Consequently, the largest percentage of nitrogen must be applied in the spring. That is, about eighty-five percent of the total nitrogen from a nitrate source for the year should be applied between the first to tenth of February and the remaining fifteen percent in May from a nitrate and sulphate source. At the time of the May application phosphoric acid and potash are also applied, giving a yearly 1-½-1½ ratio. Acid phosphate and muriate of potash are used at this time. This is all the fertilizer the tree is given until the following February. All fertilizer applied to our planting for the last three years has been from an inorganic source with the exception of 1,000 pounds per acre of muck applied this past summer. It is going to be necessary to supply some type of very slowly available organic matter such as grasses, hay, or any organic matter very low in nitrogen where sufficient natural grasses or cover-crops cannot be grown.

Weather condition is another factor determining the quality of the fruit. Our last dry sum-

mer produced a much better quality fruit as a whole over the state than ever before seen. In my opinion this condition to a large extent was responsible for the inability of the tree to take up nitrogen during the severe drouth of the late summer and fall. In summarizing the recommendations for fertilizer application on an average twelve year old tree the following program can be followed:

Feb. 1-10th: 6 to 8 lbs. of nitrate fertilizer such as nitrate of soda, nitrate of potash, calcium nitrate.

May 1-10th: Either inorganic mixed goods or materials bringing the plant food for the year up to a 1-½-1½ ratio.

The period of cultivation coincides with the spring application of fertilizer. A disc harrow is used to incorporate the fertilizer into the soil, stimulating root activity and growth as rapidly as possible as the trees are in a nitrogen starved condition. After the growth and bloom have started, further cultivation is not necessary under average weather conditions. The trees are usually hoed once in the fall of the year, but this practice has been abandoned in many cases.

Very little pruning is done in Temples. The limbs and twigs are so small that within one year they have fallen off and pruning is consequently considered only a secondary operation with us.

In conclusion may I state that by following the above practices we have produced good crops of quality fruit. This year we shipped 18,070 boxes of which sixty-four percent were U. S. No. 1, from our 150 acres of Temples. I believe that the Temple orange has possibilities of being one of the few varieties to compare or excel in prices paid for fancy fruit. In a prime stage, I dare say no other fruit can compare with a Temple in quality, individual flavor, aroma, texture, and appearance.

THE STATUS OF THE HOME FRUIT GARDEN IN FLORIDA

J. Lee Smith, Gainesville

What is the status of the home fruit garden in Florida? There is hardly any such thing as a *Home Fruit Garden* in the state and you will realize that to be true when I tell you only 2.7% of the food consumed on farms is fruit, or $14.94 out of $544.21 which goes for food.

However, Florida is not alone in this—the entire south is without fruit. In fact, parts of it have less fruit for home use than we in Florida have. And, too, having only about 6% of our lands in cultivation the wilds still furnish our tables with blueberries, haws, blackberries and a few other wild fruits to supplement what we grow.

Our state made up of such variation of soil types, climate, people, and types of farming that it is, I think I can best give a true picture of the conditions by discussing the situation briefly in various sections of the state.

I show here a plain bar chart which shows what part of the fruits needed by the people on the farm is supplied by both the wilds and fields of the farm.

This heavy line marked 100% represents the amount of fruit needed on the farm, to give the people living on the farm, what fruit is needed in the diet of the average person. The black bar represents that part of the fruit which is needed that is supplied by the farm.

JACKSON COUNTY AREA—200 FARMS

I will begin first in the north-western part of Florida and lead you to the southern part of the state.

In the Jackson County area the fruits furnished by the farms were Satsumas, strawberries, figs, blackberries, pears, grapes, pecans, peaches, plums, and a few miscellaneous. 66% of the farms had peaches, 49% figs, 32% blackberries, (And most of us know where these blackberries come from),

16% plums, 15% grapes, 6% pears, 2% satsumas, 2% strawberries, and 1% miscellaneous. It is seen here that only two fruits, peaches and figs, are on as many as 1-3 of the farms in this area. Approximately 15% of all farms failed to furnish any fruit at all. The wholesale cash value of the products furnished by these farms in 1928 was $18.48. And, as the chart shows, these farms supplied only 16% of fruit needed to feed the people living on the farm.

COLUMBIA COUNTY AREA—100 FARMS

The fruits produced in Columbia County area are not far different from that produced in Jackson County area though their supply is shorter; the chart showing that only 11.4% of the families needs are supplied from their farms. 59% of them had blackberries taken from their fields or woods, 57% had peaches, 34% had pecans. 12% of the farms here had five, or more, varieties of fruits for consumption.

The families had more than 11.4% of their fruits supplied however, as each farm purchased an average of $9.78 worth of fresh fruits. The leading fruits purchased in order of amount invested are as follows: apples $2.88 worth, oranges $2.78 worth, bananas $2.13 worth and the balance was divided between lemons, grapefruit, peaches, nuts, etc. And $3.73 worth of dried fruits were also bought. All in all the fruits furnished by the farm was only 3.5% of all the food furnished by the farm.

HASTINGS AREA—33 FARMS

The Hastings area furnished 11.7% of the fruit needed on the farm for consumption there and was worth in 1926 only $13.44. Strawberries was one of the big items in it. In fact, strawberries and oranges constituted more than 50% of the value of all the fruits named. Virtually the same varieties of fruits were produced and consumed here that was grown in the other areas, already mentioned. It is interesting to note that 40% of these farms furnished no fruit at all.

LAKE COUNTY AREA—32 FARMS

But let's go further south, say in the Lake County area. How much better have they fared? Here in 1927 the fruits used on the farm were worth $28.94. Measured in percentages of the standard quantity these people had only 25% of the fruit needed. Of the fruits consumed here, oranges, grapefruit, and tangerines, amounted to 66.8% of it. The variety here was less than that recorded in the other areas for there were no *grapes,* no *pears,* no blackberries, and no figs.

MANATEE COUNTY AREA—41 FARMS

Now let's go to the West Coast and see what we find. Let's take the Manatee County area. This area furnishes only 21% of the fruit needed for consumption on the farms. Here the variety is still worse. Grapefruit, oranges and strawberies constitute 78% of what they have. There were no grapes found, no peaches, no pears, and no pecans, yet 44% of these farms furnished some of three or more fruits. So take away from these people the fruits they grow commercially and they are in a very bad way so far as fruits grown for home consumption goes. All other fruits amounted to only 4.4% of their fruit needs. Yet one farm furnished quantities of eight varieties which amounted to 64% of needs.

SANFORD AREA—44 FARMS

Now let's look at the celery district, the Sanford area. They had the same fruits that the north Florida areas had, except blackberries. But 84% of what they had were oranges, tangerines, grapefruit, and strawberries, which certainly is O. K. as far as that goes. All the fruits these farms furnished were only 12% of what they might consume.

It is interesting to note here that in this area 36% of the farms furnished no fruits at all; 16% from 1 to 5 dollars worth, or 52% of all the farms furnished none or less than $5.00 worth of fruit for the family of 4 people; 14% furnished from 6 to 13 dollars worth; 18% from 14 to 25 dollars; 11% from 26 to 40; and 11% from 41 to 60 dollars worth. None furnished over $60.00 worth.

SUMMARY

A total of ten areas scattered all over the state have been surveyed, six of which I have covered here. It is seen that fruits for supplying the home consumption needs is woefully short. It is

seen also that it does not apply to one part of the state alone, but to all. The ten areas considered shows that apparently we are supplying about 12% of our fruit needs. Of the family food furnished by the farm, fruits made up about 2.7%.

CONCLUSION

Let me say in conclusion it does not seem to me that we have the fruits on our farms that we had when I was a boy. If this is true, why is it true? Have the diseases and insects multiplied and taken them away from us? Have we fought for their lives as hard as our fathers did? Or what has gone with our local fruit tree agent? Or have we forgotten to live? Did the high prices during the war and the boom make us forget we needed to live and we went chasing the pot of gold at the foot of the rainbow down the lane of cash and commercial crops? This situation must be corrected in this land where God intended that we should live and live abundantly off the fruits of our own land.

THE LATEST CONCERNING NATURAL ENEMIES OF CITRUS INSECTS

E. W. Berger, Entomologist, State Plant Board, Gainesville

The latest concerning natural enemies of citrus insects is that they are more numerous and therefore better on the job. This is probably due to the unusually mild winter weather, and, in so far as it pertains to the friendly fungi, the heavy dews that prevailed during much of the same period undoubtedly facilitated their effectiveness.

The friendly fungi, predatory insects, and parasitic insects, constitute the three main groups of organisms to which most of the natural enemies of not only citrus insects but of all insects belong.

There is, however, another group of natural enemies of living things, namely the parasitic bacteria. While some of these are the frequent causes of disease and death among men and higher animals and plants, we do not have in mind a single instance of their destroying citrus insects, although bees and caterpillars (so-called worms) are frequently killed in large numbers by them. It may interest a few of you to learn, that, according to some wag, bacteria are called microbes in Ireland, parasites in Paris and germs in Berlin. But to get back to our subject.

While the writer has been accused of putting *fun* into fungus, for which he does not alone deserve credit, he will today first tell something about the men that put *Leis* and *Cryptolaemus* into the orange groves of Florida.

THE CHINESE LADYBEETLE

(*Leis conformis*)

Leis is the aphid-eating Chinese Ladybeetle, at first introduced from China into California. In June, 1925, Professor J. R. Watson, Entomologist at the Florida Experiment Station, and his assistants obtained some of these beetles from California and after propagating them, liberated numerous colonies in many parts of the state infested with the so-called New Citrus Aphid (*Aphis spiraecala*), now commonly called the Green Citrus Aphid. This ladybeetle is much larger than any of our native species. Its color is light-buff or yellowish-orange with black spots on the wing covers.

What the outcome of this introduction will be remains to be seen. In Experiment Station Bulletin 182, and Extension Bulletin 67, Watson writes that an adult *Leis* may consume on an average of 200 young aphids per day, and a larva (grub) the same number. This appears promising, and if these beetles will only multiply sufficiently, should prove to be a very useful addition to the ladybeetles of Florida.

It appears, however, that out of more than 100 introductions of *Leis* made in many parts of the state, 5 or 6 years ago, only one, at Sand Lake, near Orlando, seems to have maintained itself

until the present time. Mr. L. W. Ziegler, Proprietor of the Crypt Laboratories at Orlando, formerly connected with the Experiment Station at Gainesville and the work of introducing both the *Leis* and the *Cryptolaemus*, writes encouragingly as follows under dates of April 16 and 23, 1932:

"In a row of 25 trees at the point of original infestation (1925) an approximate average of 2.5 to 3.5 beetles were found per tree. Many egg clusters were also found.

"Contrary opinions notwithstanding, I believe that this interesting phenomenon of survival (after apparent failure elsewhere) is due to the succession of host material (aphids) on various-aged tangerines, some of which are apparently succulent at all times of the year."

It appears, therefore, that the Chinese Ladybeetle has successfully maintained itself during 5 or 6 years in the citrus area in question, and Mr. Zeigler is very optimistic that it will be possible to successfully establish it in other parts of the state.

MEALYBUG DESTROYER

(*Cryptolaemus montrouzieri*)

Like the Chinese Ladybeetle, this useful insect is another ladybeetle that has recently (1930) been introduced into Florida from California by Profesor J. R. Watson and his assistants. This ladybeetle has been effectively employed in California for some years in the control of mealybugs. It was introduced into California from Australia, in 1892, by Albert Koebele, the same man that went after the Vedalia in 1888 and 1889.

Unlike most other ladybeetles, it appears that this species is not able to maintain itself year after year so that a method for propagating it in large numbers has been devised. This consists briefly in raising large quantities of mealybugs on potato sprouts, infesting the mealybugs with the beetles, and then shipping the young beetles to the groves where they are needed. About 10 beetles per tree are colonized.

In California, large insectaries for propagating these beetles have been constructed. In Florida, however, while the work was started by the Experiment Station, the further propagation of the beetles is at present in private hands, namely the Crypt Laboratories at Orlando, of which Mr. L. W. Ziegler is proprietor.

Undoubtedly much more will be known in regard to the usefulness of the Mealybug Destroyer in Florida by the end of another year.

Of the several other ladybeetles, the predators belonging to the Fly Family and the minute wasp-like parasites of citrus and other insects, in Florida, I can only state that they are on the job in so far as the writer has discovered. No outstanding facts or observations have come to his attention. If there are any persons present, and I presume there are, who desire additional information on the natural enemies of citrus insects, I suggest that they send to Gainesville for a copy of Extension Bulletin No. 67, Citrus Insects and Their Control. This is a revision of Experiment Station Bulletin No. 183.

THE VEDALIA

(*Podalia cardinalis*)

I can, however, not altogether desist from making a few remarks on a pet of my own, namely the Vedalia, or Australian Ladybeetle, a specific for the control of Cottony-Cushion Scale. The Entomological Department of the State Plant Board has been distributing these useful beetles now since about 1916. At times we have our troubles in meeting the demand while at other times we have an oversupply. In other words, the production and distribution of Vedalia has its depression and boom periods. But the price never fluctuates with the "supply and demand," it always remains $1.00 per colony of ten, this charge being made by the Plant Board to cover the cost of carrying on the work, there being no state appropriation for that purpose.

What I desired to bring out, however, in a discussion of the Vedalia, is this, that these useful beetles appear to have been more active, presumably due to the mild winter, than during some other winters. For instance, several winters ago we experienced an unusually great increase of Cottony-Cushion Scale on part of the Horticultural Grounds here at Gainesville. We colonized the Vedalia, but the scale continued to increase until late in spring, when, as the weather became

warmer, the Vedalia swept through like wildfire and by the advent of summer no live scale was apparent. The Vedalia can be depended upon to effect a clean-up even if delayed by cool weather.

In February, Mr. Frink, horticulturist at the State Farm, Raiford, Florida, wrote requesting one or two colonies of Vedalia. As we happened to be out of a supply, I wrote back requesting that some Cottony-Cushion Scale be sent us. (We frequently request correspondents to send us Cottony-Cushion Scale since we are always in need of it for feeding young Vedalia that we raise in the laboratory.) A nice lot of scale came promptly to hand containing several live Vedalia. Upon being apprised of this, Mr. Frink, evidently grateful over the discovery of Vedalia among the scale, promptly forwarded us another lot of scale containing more Vedalia. It goes without saying that the Cottony-Cushion Scale at Raiford has been effectively controlled by the Vedalia already there. Furthermore, collecting a few dozen Vedalia from an infested property, as in the case instanced, does not materially deplete the supply because where a collector sees and collects one, a dozen are passed by.

I have, on several occasions, undertaken to make estimates of the actual money value of the Vedalia to the State. Cottony-Cushion Scale has been found from Pensacola to Key West, and from Fernandina to Everglades; in other words, in every part of the State. Assuming that, without the Vedalia, it would be necessary to spray 300,000 acres of citrus in Florida, not to mention many non-citrus plantings and ornamentals, five or six times a year in order to effect a satisfactory control of Cottony-Cushion Scale, and assuming a very low spray cost of $3.00 per acre we would have a spray bill of $900,000 for each spraying, or $4,500,000 for five sprayings. Such a tremendous annual spray bill is saved to the growers of Florida as a direct result of the introduction of the Vedalia. This annual saving of $4,500,000 is approximately one and one-half times the total resources (consisting mainly of federal and state appropriations) of the Florida Experiment Stations for the past ten years (1922-1931, inclusive). (See also the last section of this paper, especially the last two paragraphs.

Furthermore, the value of the Vedalia to the state, as previously estimated, is just about 19 times the recent (1931) annual state appropriation for the Plant Board of approximately $235,000. But, of course, only a very small part of this ($8,000) is budgeted for the Entomological Department.

Something like 200 to 250 colonies (consisting of ten Vedalia each), or 2000 to 2500 Vedalia, are distributed each year to growers who have need for them, at a nominal cost of $1.00 per colony. The fact that there is this annual demand among growers for additional Vedalia, indicates that the natural Vedalia population of the state does at times fall short either in numbers or distribution, thus making desirable the introduction of additional numbers of Vedalia.

The value of the 200 or 250 colonies of the Vedalia sent out annually to growers who request them at a nominal cost to them of $200 to $250 is very difficult to estimate. But allowing that each colony eventually replenishes the needed Vedalia population in 100 acres, we have 25,000 acres benefited by this distribution. At the postulated cost of spraying, $3.00 per acre, this gives us a saving of a $75,000 spray bill for one spraying. How many additional sprayings might be necessary before some Vedalia from some nearby locality found such an infestation of Cottony-Cushion Scale is problematical. Nevertheless, the total annual appropriation of approximately $8,000, as budgeted for the Entomological Department of the State Plant Board, spells but a bagatelle, were it all spent on the Vedalia Project, which it is not.

THE ENTOMOGENOUS, OR FRIENDLY, FUNGI

At last we come to the Friendly Fungi. An extensive account of these would not be new to the majority of listeners present. However, we occasionally have to repeat some parts of our stories for the benefit of the newcomers in the business.

I will, therefore, not undertake to tell you much detail about the friendly fungi today. In explanation, a fungus is a type of plant-growth like the blue and gray bread molds, mushrooms and toadstools, and the friendly fungi vary in color

and shape not unlike the molds, toadstools, etc. In size, however, the friendly fungi are generally very small, being limited in size by the size of the insects infected. They are called Friendly Fungi because they destroy many injurious insects that infest citrus and other plants. In other words, they are parasites that destroy injurious insects. Of course, there are other fungi and their close relatives, the bacteria, that sometimes parasitize useful insects (such as the honey-bee and the silkworm), plants and higher animals, but we are not dealing with these here.

We have listed sixteen friendly fungi that may at one time or another destroy injurious insects infesting citrus and some other plants. Five of these destroy one or several species of whiteflies, five destroy several or more species of the common armored scales, two destroy several soft scales, one the Florida Wax Scale, one the Citrus Mealybug, one the Rust Mite, one the Cottony-Cushion Scale and one the Green Citrus Aphid, until recently generally known as the New Citrus Aphid.

The five that destroy whiteflies are:

Red Aschersonia (Red Whitefly-Fungus)
Yellow Aschersonia (Yellow Whitefly-Fungus).
Brown Whitefly-Fungus.
White-Fringe Fungus.
Cinnamon Fungus.

Of these, the Yellow Aschersonia, alone limits its parasitism to only one species of the whiteflies infesting citrus, namely the Cloudy-Winged Whitefly and to one or two unidentified species of whitefly occasionally found infesting dahoon holly and swamp bay in hammocks. In so far as known, these are its only hosts. The other whitefly-fungi may destroy several to many species of whiteflies.*

The Cinnamon Fungus is a parasite of several species of whiteflies as also of several species of scale-insects, and appears to be the only friendly fungus that has this double role of parasitizing insects in two distinct and separate families.

The five fungi that frequently destroy several or more of the common armored scales of citrus and other plants are (See also footnote):

Red-Headed Scale-Fungus.
White-Headed Scale-Fungus.
Pink Scale-Fungus.
Cinnamon Fungus (Occasionally).

The Cuban Aschersonia and the Cephalosporium Fungus destroy several soft scales, mostly on other plants but occaisonally on citrus.

The Turbinate Aschersonia is the natural enemy of the Florida Wax Scale, infesting citrus and other plants.

The Rust-Mite Fungus destroys the Rust Mite.

The Cottony-Cushion Scale Fungus occasionally destroys this scale whether on citrus or other plants.

The Aphid Empusa destroys the Green Citrus Aphid (so-called New Citrus Aphid).

The Mealybug Fungus destroys the Citrus Mealybug and others.

It would take me too far afield were I to enlarge further on the friendly fungi. Details may be found in the bulletins listed in the preceding footnote. Most fungi, however, require an abundance of moisture, at least a humid atmosphere and warmth. These requirements are generally best fulfilled during the period of summer rains and we do not as a rule recommend the use of the friendly fungi earlier. But as previously noted, the preceding relatively warm winter with frequently heavy fogs has been an exception and it has been observed by Professor J. R. Watson and myself that the friendly fungi have been unusually active. Even the Aphid Empusa was observed by Watson and his men as destroying many aphids whereas this fungus has generally been observed as not becoming effective until later in the season, April, May or even June.

It must not be omitted here that heavy cover crops, especially during periods of rain, are very effective in conserving the degree of humidity necesary for the thriving of the friendly fungi under discussion.

*For complete lists of the different species of insects destroyed by the friendly fungi named in this paper, Florida Experiment Station Bulletin No. 183 or Co-operative Extension Bulletin No. 67. may be consulted. Bulletin No. 183 is just out of print, but Bulletin No. 67, a revision of Bulletin 183, will be available by the time these Proceedings are printed. For copies of Bulletin No. 67, address Co-operative Extension, Gainesville, Florida.

I nearly overlooked stating that the Entomological Department of the Plant Board has been growing pure cultures of the Red Aschersonia (Red Whitefly-Fungus) and one or two others, since about 1916. This work is being continued and we again are preparing to grow about 2,000 cultures for distribution. A culture, the amount of fungus that can be grown in a pint wide-mouth bottle, is sufficient for treating an acre of whitefly-infested trees. The charges are $1.00 per culture, about enough to reimburse the Plant Board for the cost of production, there being no appropriation for this work.

Methods for growing the principal fungus enemies (Red-Headed Scale-Fungus, Pink Scale-Fungus and White-Headed Scale-Fungus) of the common armored scales, such as the Purple Scale, Long Scale, Chaff Scale, Florida Red Scale, and others, have not been perfected, and cannot, of course, be supplied in pure cultures.

WILD ENTOMOGENOUS FUNGI IN HAMMOCKS

As early as November, 1919, some fungus material on dahoon holly and swmp bay, collected by employees of the Plant Board, was received from the Brewer Hammock of Winter Park, Florida. (Proceedings, 1922). Additional material has since been collected at Winter Park, and the hammocks at Magnesia Springs and Prairie Creek, both near Gainesville, Florida, by the speaker and others. Aside from the Cephalosporium Fungus and the Cuban Aschersonia on two soft scales, and the Turbinate Fungus on the Florida Wax Scale, four aschersonias, infecting the larvae of one or two native species of whiteflies, have been almost regularly found on such material. Two of these are the Red Aschersonia (Red Whitefly-Fungus) and the Yellow Aschersonia (Yellow Whitefly-Fungus). The other two are *Aschersonia brunnea* and *Aschersonia basicystis*. The first two are, of course, well known in citrus groves as effective parasites of whiteflies, but the last two have never been received from groves and presumably will not infect the whiteflies that infest citrus in Florida, as they certainly have had plenty of time to spread to them. The writer, has, furthermore, made several unsuccessful attempts to get them started on whiteflies infesting citrus.

The question at once arises, assuming that *A. brunnea* and *A. basicystis*, are native to Florida, which they apparently are, are not the Red Aschersonia and the Yellow Aschersonia also native, and that they gradually found their way from the hammocks to the citrus groves? This statement does not necessarily imply that they are not also native to other parts of the world.

VALUE OF THE FUNGI TO THE STATE

The question of the monetary value of the entomogenous fungi to the State is sometimes asked. It is, of course, impossible to arrive at any very definite figures except through the initiation of an extended research continued over several years. Estimates, however, have at times been made, of which the following one is regarded as very conservative.

The value of the friendly fungi to the State may be gathered from the fact that they save the citrus grower at least one spraying with an oil-insecticide annually. In some instances two, if not more. This elimination of one oil spray annually takes place, furthermore, at a time when summer rains are likely to interfere with its effectiveness. It is then, on the other hand, that the friendly fungi are most active and effective. Allowing that there are 300,000 acres of citrus in Florida that are saved one spraying annually by these fungi, we have the handsome sum of $900,000 saved to the growers of the State each year, allowing that it costs only $3.00 to spray an acre. However, I am advised by a grove expert that five or six dollars per acre would be a better average for the cost of spraying groves. Allowing, therefore, five dollars per acre, we have the still more handsome sum of $1,500,000 to the credit of the friendly fungi.

How much or how little the scientific workers that have spent time investigating the friendly fungi and devising means for increasing their effectiveness may be credited, is also difficult to ascertain, but it does not seem unreasonable to assume that their studies have in some considerable degree, at least, facilitated the general usefulness of the friendly fungi. I am thinking

particularly of the better methods for introducing and distributing these fungi, as worked out by the Experiment Station workers and others, and especially the culture method of producing the Aschersonias, especially the Red Aschersonia, in large quantities in the laboratory and distributing them to growers that are in need of this fungus.

The financial resources of the Florida Experiment Stations, consisting mainly of Federal and State appropriations, during the past ten years, as summarized from their annual reports (1922 to 1931, inclusive), amount to $2,816,130.98.

From these figures it becomes apparent that the money value of the entomogenous fungi to the state during two successive years more than covers the cost of operating the experiment stations during the past ten years.

Deceased Members

Captain Rufus Edwards Rose

Edward Simmonds

S. H. Gaitskill

George A. Galliver

E. S. Williams

Captain Rufus Edwards Rose, 1847-1931

REPORT OF THE COMMITTEE ON NECROLOGY

The Committee on Necrology reports the passing of the following members:

S. H. Gaitskill, McIntosh.
E. S. Williams, Ft. Pierce.
George A. Galliver, Orange, New Jersey.
R. E. Rose, Tallahassee.
Edward Simmonds, Miami.

These men have been members of the Society for many years and have taken an active part in its deliberations in the past. It is not known that this list is complete and the Committee will appreciate members reporting any deceased members of the year that are not included. Proper obituaries will be prepared and printed in the 1932 Proceedings.

COMMITTEE.

(The adoption of the foregoing report was moved, seconded and unanimously carried).

CAPTAIN RUFUS EDWARDS ROSE

Captain R. E. Rose, who died on April 23, 1931, after an illness of nine months, was for over thirty years a member of the Florida State Horticultural Society, although the infirmities of age prevented him from attending any of the meetings of the association during the past eight years.

Rufus Edwards Rose was born in New Orleans, La., on March 19, 1847, the son of Alfred James and Albina Stanhope Rose. After the usual course of education in the public schools he entered the Dolbear Technical and Commercial College, where he specialized in chemistry and pharmacy. His studies at this institution were, however, interrupted by the operations of the Civil War, in which he served with distinction in the Supply Corps and in the Navy of the Federal Government. His father was the Captain of the Federal gunboat Diana and it was from him that the son acquired his first knowledge of engineering and navigation.

At the conclusion of the Civil War young Rose was occupied for over ten years in various agricultural and industrial enterprises of his native state. He assisted in the establishment of the first artificial ice plant of New Orleans and also designed and erected a number of sugar mills in Louisiana. He was for a time a captain of steamboats on the Mississippi and Red rivers and from 1876 to 1881 was superintendent of the Louisiana Reclamation Company, taking an active part in the work of reclaiming the peat and muck lands in the Mississippi delta.

At this time Mr. Hamilton Disston of Philadelphia was busily engaged in his colossal enterprise of draining and reclaiming four million acres of Florida Everglades lands. He noted the reclamation work of Captain Rose in Louisiana and offered him a wider scope for his activities in Florida. The acceptance of this offer led to Captain Rose's removal to Florida, where he spent the remainder of his life. From 1881 to 1886 he was superintendent of the Disston Everglade Drainage Company and from 1886 to 1889 of the Disston-St. Cloud Sugar Company.

Following his connection with the Disston companies Captain Rose became interested in a number of activities which had for their object the promotion of the agricultural and industrial prosperity of Florida. He was connected with the Florida East Coast Railroad Company as land agent and agriculturist; he also took a prominent part in prospecting and developing the phosphate deposits of Florida.

Captain Rose's connection with the Florida State Horticultural Society began with his appointment in 1901 as State Chemist of Florida, in which capacity he served continuously until the time of his death. He was the author of all the control laws directed by this office that were enacted in Florida during this long thirty year period. He was particularly zealous in securing

the passage of legislation that would secure the proper maturity of the citrus fruits of Florida which were placed upon the market.

As a member of the Association of Official Agricultural Chemists of which he was a member for more than thirty years, Captain Rose presented a paper at the 1905 meeting upon "What Variations from Maximum Guaranteed Analyses of Fertilizers and Feed Stuffs Shall be Considered Adulteration or Deficiencies?" (Bur. Chemistry Bull. 99, p. 100), a paper at the 1916 meeting upon "A Study of the Availability of Potash in Commercial Wood Ashes" (Journal of association of official agricultural chemists, 3, 323: 1920) and a paper at the 1923 meeting upon the "Florida Fertilizer Law" (Journal of association of official agricultural chemists, 7, 376: 1924).

Captain Rose was an organizer of the South Eastern States Food and Drug Officials Association, of which he was a president, and later Honorary President until his death. He was also a member of the Association of Dairy, Food and Drug Officials of the United States and as president of this organization presided in 1921 and 1922 at the Conventions at Miami and Kansas City. respectively. From 1920 to 1925 he was a member of the National Food Standards Committee. He was also an active participator in the work of the Southern Cane Growers Association, of the Southern Agricultural Workers and of various fraternal organizations.

In addition to the numerous reports which he published in connection with the work of his office as State Chemist of Florida Captain Rose was the author of works upon "The Everglades of Florida," "The Sugar Industry of Florida" and "The Drainage of Farm Lands." He was active in the Florida State Horticultural Society, appearing repeatedly upon its programs, his various addresses being published in the proceedings of this Society.

There are few members of our Society who have had a career so picturesque, so varied and so active as that of Captain Rose. He was a man of most pleasing personality, and the members of the Association who have visited Tallahassee can speak of the hospitality which they received from him and his charming wife in their beautiful Southern home. Captain Rose is survived by his widow, Mrs. Mary Morgan Rose, by his daughter, Miss Muriel Rose, and by his son, Lieutenant Rufus Edward Rose, U.S.N., a graduate of the U. S. Naval Academy at Annapolis.

Adapted from an obituary by C. A. Browne, Association of Official Agricultural Chemists.

EDWARD SIMMONDS
A Real Plant Pioneer

By David Fairchild, Coconut Grove, Fla.

I wonder why it is that some people seem able to dramatize every incident of their daily lives, while others pass through the events which make up their days as though each one were a commonplace. At life's close the one has a picture gallery of vivid scenes and incidents, while the other has a blank wall of drab nothings which he calls the past. The one goes through life with the eager interest of a little child in the woods, but the other drags along a dusty road just to go somewhere.

The life that has just closed was so filled with daily drama and romance, so colored with the beauty of plants, that I cannot let it slip into oblivion without an attempt to describe to those who might like to hear about it, some of my reasons for thinking it one of the most remarkable and quietly fascinating lives with which it has been my pleasure to come into close personal contact.

Edward Simmonds' life has been closely woven together with my own for almost a quarter of a century, for he has had the pleasure, I use the word "pleasure" advisedly, rather than the narcotic word "job," of growing many hundreds of the new plants which I have had the pleasure

of finding and sending to America. Others too have grown these new plants, and some have thrown them away, while others have drifted into "business," where more money could be made and more luxuries bought, but Edward Simmonds found the romance which lies in the growing of new plants. The daily grind in the sun, the sweat and worries of the field, the slowness with which plants grow and the uncertainty of their flowering and fruiting—all the vicissitudes connected with a plant's life, he was able to dramatize. The fact that it would be eight years before some new plant could bear the expected fruit, never daunted him for they would not be just eight long years to him. He realized, as few have done, the fascination there is in watching every step of a new plant's growth. Something dramatic and momentous is occurring in the plant from the instant its seed is in the ground and one scans the surface of the seed bed with an eager eye to find if there is a slight rise in the soil to indicate that it is sprouting and that the race is on; until one can stand under its great branches and stroke its bark,—and Edward Simmonds knew it.

I know there must be some women who do not like babies, who are always wishing their children were grown up, 'who do not even take the pains to photograph them when they are at that fascinating age between two and three. So also there are gardeners who only plant for future pleasure or gain, gardeners who see no charm in a baby plant. No one who had seen Simmonds hovering over a seed bed would ever put him in that class.

Strange as it may seem to some perhaps, there are too many dramatic things happening every morning in a garden to give a real plantsman time to be interested in those human dramas with which the stream of thin, rolled out paper-pulp we call the press, is slowly flooding the literate world. I sometimes wonder if it would be possible for a man who has spent the morning hours reading of the doings of those fleeting thousands whose actions fill the daily papers, to retain sensibilities keen enough to perceive the silent, slow-moving change of events in the plant world, and to read into them enough importance to dramatize them, as the inventor in his garret dramatizes the fantasms of his imagination.

I think a suitable philosophy of life is as important in the making of a great plantsman as is knowledge, for without it the dramatization is not a continuous performance, but a lot of disconnected scenes.

The closet naturalist, the laboratory scientist, the mathematically minded, the people to whom gardening is measured by the number of plant names they can keep at their tongues' ends, indeed nearly all of us, have some formula, some theory of our own by which we explain the behavior or the "success" of our acquaintances. Very few of us realize that, as my friend Dr. Baekeland puts it, a theory is like a straw hat; it serves its purpose for a certain length of time in the summer, but when in the course of time the wind changes and the snows come it must be thrown aside. Edward Simmonds instinctively understood this; he began theorizing about his plants the minute he had their seeds in the ground. If they were late in coming up he had a theory to explain it. If they came with a rush he had another. As they grew older he was wise enough to change to a theory of another class, and with every setback in their behavior, he formed a new hypothesis. How often I have seen some closet naturalist look sceptical, or pick some flaw in Simmonds' latest theory, never stopping to realize that it was by means of these hypotheses that Edward felt his way along, and gained experience, and kept the romance of his life going.

No! Some adequate philosophy of living things one must have, something to prevent chaos from entering and destroying our garden world. We need hypotheses to be tested every day, and thrown overboard without a regret; foolish, futile experiments we might call them if we wish.

As I look back through the years to the first time that I met dear Edward Simmonds, I am concious that I am looking back almost to the very beginnings of gardening in South Florida—back to the beginnings even of an American appreciation of the existence of a world of tropical plants. Is it any wonder then that as I write these words, I can feel keenly the boyishness of our early efforts?

We were a bunch of boys. By "we" I mean the little group of Agricultural Explorers, and

Plant Introducers, and Field Garden Experimenters. Some of us went in search of new plants, and thinking that some plant that was of value in a foreign country might grow and have a use in our own, we sent seeds or cuttings of it back. Edward Simmonds had to make them grow if he could. His was the intimate pleasure of watching their first behaviour in a new home.

I say pleasure, but quite as often this was pain, for South Florida was then the least known agricultural region, with the most peculiar soil and climatic conditions, in the whole United States. In fact there are very few regions in the entire world which presented more problems than did this tip end of the peninsula.

There were no precedents to follow. The books on gardening elsewhere, did not apply here. The theories of fertilization in vogue in the North had to be reversed here, at least as regards lime. The methods of planting out a potted plant, the practice of mulch versus clean tillage, the use of rocks, and the whole problem of soil drainage had to be worked out.

Added to all this there was the fact, which was not immediately recognized, that although the climate was essentially tropical, there were yet, freezes every once in a while. Then to this almost inconceivably complex situation had to be added the risks from the strong winds of late summer, the great blows. As our knowledge of the whole plant situation grew, there came into it the further problems of the absence in certain of our soils of some of the rarer metals, like manganese, the addition of which has made revolutionary changes in the plants. Lastly, and only to be appreciated after much practical experience, there has come to the front the very important problem resulting from the intense radiation from the sun; this is much more intense in Florida than that which comes through the greater bulk of moisture generally prevailing in regions as tropical as Florida. Edward Simmonds realized this factor early in his career, for he saw plants sent him from the tropical regions of Asia, fade before his eyes if they were not given some protection from the late afternoon sunlight. To the study of all these problems Edward Simmonds contributed in very large measure.

In the midst of all this fascinating assembly of factors affecting the plants he was trying to grow, he lived the quiet life of a real plantsman, although there surged around him a swarming, struggling, mass of people who, during the time of his stay in this region, transformed Miami from a hamlet set about with fascinating low jungles, or "hammocks", into an airplane-filled, yacht-basined, boulevarded, traffic-lighted metropolis which tries to have a sky line like that of New York.

Of the speculative profits in land sales, of the "get-rich-quick" phases through which the development of the whole vast Everglades area passed, Edward Simmonds was a calm and philosophical on-looker. He contributed his expert advice as far as his actual experience with conditions affecting plants allowed him to go, but stopped short when anything which looked like propaganda began to creep in. For it was quite natural that in this region so filled with new possibilities, every new plant which came in was scrutinized by a certain public to see if there appeared a chance to turn it into money, or use it for the advertising of lands for sale. If so, it immediately became a tool of the boosting class, which meant that its possibilities were usually grossly exaggerated.

To hold his enthusiasm and his hope for one of these new plant immigrants, and yet to keep his head with regard to its limitations, never allowing his judgment to overlook any signs of unsuitability to the conditions of soil and climate, was something which tried the memory, the power of analysis, and the diplomacy of this practical plant-lover beyond anything ordinarily imagined by the gardeners of the more established horticulture of the North Temperate Zone.

The little Plant Introduction garden of six acres, around which the city of Miami has grown up, and which, since the devastating hurricane of 1926 has been left to become a jungle almost as dense as one in Panama would be, constituted the first American doorway, so to speak, to the world of tropical plants, at least as far as American plant-lovers were concerned. It was the place, and the only true place, where hosts of new plant species from all over the world first set foot on

American soil, and Edward Simmonds lifted thousands of them from their little seed beds and carefully put them into the pots and boxes, from which later they were slid carefully into the rocky pockets made for them in the limestone soils of South Florida.

Few of the people to whom new plant material was sent were equipped, or knew how, to give them ideal conditions. Edward Simmonds came nearer being able to do this than anybody else, and so, quite naturally, around what was essentially a propagating garden there grew up collections of the plants which were being propagated and distributed.

As I look back to the days long ago, when we used to go from plant to plant, note book and camera in hand, recording the behavior of each new tropical species, I feel again the thrill which came with the discovery that some species, which perhaps one of our explorers had found on the Rio San Francisco, in Brazil, or some foreign correspondent had sent in from Cochin, China, or I myself had found with Mr. Lathrop in East Africa, was growing well and showed signs of flowering.

It is of course true that we were many times deceived. Some of the grasses which, in our imaginations, were to convert the Everglades into pastures, did not convert them. Some of the forest trees which should have spread over them did not spread. Some of the delicious vegetables which ripened for the first time in that little garden failed to make the converts which we thought, and still think, they should make. Some of the fruit trees which flowered failed to fruit; some fruited but dropped their fruit; some developed disease and had to be cut down; and with the coming of the great freeze in 1917, some disappeared forever from Florida.

I was there when the great freeze came, and saw what had been a landscape of vivid green turned overnight to one of mahogany brown or ashey grey—dead leaves everywhere in place of living ones. I recall how, together, we gathered a herbarium of the frosted leaves, and made photographs of all the trees to show the reaction of each species to the temperature of 26.5° F., and watched the recovery, or death, of plant pets which were then unique in America, and whose growth we had watched so carefully for more than a dozen years.

Certain species which we thought were tender, because they had come from ultra-tropical regions, proved hardy. Others on which we had counted as being hardy enough to be sent further north, went down and disappeared completely from view. We were watching the process of Natural Selection, and got a very good idea of the way the coming of the ice age must have swept back toward the Equator the forests and fields of frost-tender species.

It is true we mourned over those which were "taken," but there were so many that were "left", and the whole slow process of recovery was so fascinating that even Edward drowned his sorrows in the new world of facts which the freeze brought to our door.

But the saddest of all the disappointments, and one of the most tragically sad experiences of Simmonds' life, was to have three feet of salt water sweep over the little garden, and a hurricane wind blow hundreds of precious trees out of the ground.

I was away at the time and only saw the little garden after the debris had been cleared away, but it came so near being heart-breaking that I have always marvelled that one with so deep an affection for all its trees and shrubs as Edward, could recover from the shock. It was here that the real plantsman's philosophy came in. He found himself in a changed world, it is true, but plants were growing around him everywhere, they needed his care and attention, and, as he handled the pruning shears or the saw or the knife, he transformed into activity the worry and brooding which such a catastrophe might easily have converted into brain storms.

I recollect his telling me once of the comfort which plants were to him, and what they could be to others. One of his unfortunate friends came to get comfort from him, as many did, and began to tell him of his marital troubles. "I took him right out among the mango trees" said Simmonds, "and showed him how *inter-esting* they

were, and made him forget all about his wife and divorce troubles."

Edward Simmonds' contributions to the horticulture of South Florida are concrete ones; they are not embodied in the papers or articles he ocasionally read before the Horticultural Society.

It was his intelligent handling of the hundreds of forms of the papaya that resulted in the saving of the best form from Panama; "28433," was the only name he ever gave it. This strain entered into the best of the so-called Blue Stem Bisex selections. It was a hermaphrodite strain, and, like all the others, not always reliable, but none the less, it is the best in South Florida.

Simmonds was wholly responsible for the emergence of the Simmonds, the Collinson, and the Winslowson avocados in South Florida; three of the best varieties now grown there. The first two were, so to speak, his selected seedlings from direct introductions of Guatemalan origin, and there are probably more young avocados of these varieties being planted out in Florida now than of any other sorts. The variety bearing his name has proven particularly valuable in Porto Rico, Panama, and Hawaii.

In 1910 Edward Simmonds crossed the cherimoya and the sugar-apple and raised a quantity of seedlings, one of which he crossed again with the custard-apple. From these various crossings has emerged at least one hybrid that, so far, seems a better fruiter than the ordinary cherimoya, which is reported to be a very shy bearer at sea level.

He made a more careful and critical study of the mango than any one else in Florida was able to do, because it fell to his lot to raise from scions or pot-plants, over 75 varieties, introduced from all over the world. It was his keen perception of character that enabled him to single out the Sarigon variety from Cochin, China, and to show that, although not so brilliant and showy a mango as the Haden, it was a more reliable bearer. He raised a lot of seedlings of the Sarigon, and made some crosses of it with other varieties, and it was the concern of his last days on earth that these might be saved, and propagated, for a wide trial throughout the state.

His last piece of horticultural work, just a few days before he went to the hospital, was to put a bud from one of his hybrid cherimoya sugar-apple trees, growing on my place, into a pond-apple-seedling on Dr. L. H. Baekeland's place, the "Anchorage" in Coconut Grove. Our idea was, that with a pond-apple stock, the cherimoyas might be grown in the low marle prairies along the coast of South Florida, which is the most frost-free area in the state.

The list of introduced shade trees, ornamental vines, fruiting shrubs, forage grasses, lawn grasses, and cover crops that Mr. Simmonds picked out and propagated and, to a greater or less extent, popularized, would be a very long one. He was responsible for them during their first days in this country, and it was a responsibility which he always appreciated. He may have had prejudices against certain plant species, but he kept them pretty closely to himself.

In the technique of budding the mango and avocado, he contributed his part, just as he did to the questions of soil treatment. He was an early advocate of the use of humus in the South Florida soils, and of the need of mulch for trees; his pet cover crop was the Sarawak bean, *Dolichos hoseii*, and he never lost an occasion to explain its good qualities.

In the management of the three gardens in the Miami region, which were developed one after the other, it was his executive ability, quiet diplomacy and common sense that made them successful. It was one of the great trials of his life that, at the outset, the activities in South Florida were carried out on rented land, and shifts of base had to be made in order to secure an adequate area upon which to grow the increasing number of new plants.

Had he not possessed a particularly retentive memory for numbers and plant characters, the task set him of keeping track of thousands of plants would have been impossible. Unlike the superintendent of a botanic garden, whose plantings are more or less permanent, Simmonds handled a continual stream of new plants, in quantities comparable with those turned out by a nurseryman, and they had to be kept straight under a rather cumbersome but necessary system

of numbers, and with help that, in the early years at least, was transitory and unsatisfactory.

He was a good trainer of boys in the careful technique of plant propagation, a technique which he himself loved to experiment with, and although he might cling to some methods which were obsolete, he was never averse to trying new ones.

But any picture of Edward Simmonds would be quite incomplete without one of Mrs. Simmonds as a background, for it was she who made his home, and with the remarkable regularity of which so few seem capable nowadays she had everything in its place, and everything happened in his life on time. I very much doubt if his delicately balanced constitution could have lasted long in any hurly-burly world into which social life with evenings out and card parties played a part. When the long hours of the work day were ended and Mrs. Simmonds had given him his simple dinner, he loved to stroll out with his pipe among the plants to see with a quiet thoughtful mind what was going on among the hundreds of plants over which he kept watch. It was Mrs. Simmonds' practical mind and keen interest in the personalities of those who came to the garden that in numerous instances protected Edward from those mistakes of polity which most men who are engrossed in plant affairs seem liable to make.

Edward Simmonds was an Englishman. He was born in the county of Herefordshire in 1866 and his father, he used to tell me, had charge of the machinery on a large estate there. He himself at one time had charge of the owner's fine horses and knew how they should be cared for and even how they should be ridden. He emigrated to America when he was twenty and went first to stay with his brother who owned a farm in Wisconsin. From his brother's farm he went to Chicago and entered the employ of Mrs. Leiter and went to Washington later as a gardener of her place on New Hampshire Avenue. It was characteristic of him that, seeing some rhododendrons about the house suffering for want of humus he should order some leaves for them, but when Mrs. Leiter came back and saw the bill she refused to pay it and Edward quietly paid it himself.

Thanks to the acquaintance of a brother of "Boss" Shepard, Simmonds was able to get into the Government service; he called Edward to the attention of Mr. Brown who was at that time in charge of the Whitehouse Greenhouses on the Mall.

Mr. Brown gave him the job of tending the furnace and doing other odd work about the greenhouse but Edward was restless under this kind of work and went one day to see the head gardener of the Department of Agriculture Greenhouses, Mr. Byrnes, and was introduced to George W. Oliver, the Plant Propagator of the Department. Mr. Oliver was at that time at work on the mango, and mangosteen, trying various methods of propagation. His first question to Simmonds (as Edward often related) was "Do you know anything about Mangos? Have you ever seen them?" Upon his answering that he knew nothing about them, Oliver said "Then you'll do I guess." This was in 1906. Mr. Oliver had grown a vine of superb *Camoensia maxima,* the largest and in some ways the most interesting of all the leguminous plants; and it was in flower for the first time, filling the greenhouse with its fragrance, and Mrs. Fairchild and I went to see the lovely thing and there, for the first time, I met Edward Simmonds. How little did either of us guess that our lives would be so closely associated for a quarter of a century in the southern end of the then new state of Florida!

A man familiar with tropical plants was wanted for the tiny garden in Miami, which then was nothing but an experiment and to Edward's associates "a rock pile among the rattlesnakes and mosquitoes." Edward took it, and in 1908 settled down in the little garden on Bricknell Avenue in Miami and for twenty-three years devoted his whole energy unsparingly to the study of the stream of new plant introductions which the explorers and correspondents of the Division of Foreign Plant Introduction poured through his hands into the gardens of eager experimenters wherever they were found throughout the southern portions of the country. I do not know, and it would be difficult to find out how many kinds of plants his careful attention nursed through their babyhood nor how many hundreds of

thousands of individuals these represented, but I do realize whenever I travel through South Florida that here and there everywhere I see shade trees or fruit trees or shrubs or grasses or cover crop plants which when I trace them back in my memory I find came under Edward Simmonds care at a critical time in their history in this country.

It was never Edward's ambition to build any monument to himself through the sending out of these plants. He simply loved the plants and loved to see people growing them, and every moment of his waking hours was passionately devoted to working with them or talking about them. Had he been able by some device or other to make every plant carry his name as Ford made his automobiles bear his, he might have developed the same sense of personal greatness, and his name might have lived longer in history, but what would this have profited him? It would have distracted his attention from the plants in which he took his chief delight, and lessened the thrilling experiences which he was having every day in his intercourse with the amazing kaleidoscopic world in which he lived.

Edward Simmonds had always to harbor his strength for he was essentially a frail person, though with a wiry disposition and with certain muscles trained to a remarkable quickness and accuracy and with unusual eyesight. Somewhere in his childhood or youth, he could not discover when, he was attacked by the tubercle bacillus which left him with only one lung—a fact which he never discovered until late in life, and it was tuberculosis which finally caused his death on May 6th, 1931, after a long siege of ill health and indigestion. The last three months of his life were spent at home, in his charming little house at Cocoplum Heights. He had made an experimental garden of his place, filling it with a collection of the plants he particularly wanted to work with, and I had hoped that in the twilight of our lives we might often wander there under the mango and avocado and lichee trees, and plan for a better future for these fruits in Florida.

As I look back to the days of my association with Edward Simmonds and try to look forward to a Florida without his friendly enthusiasm, I am conscious of a deep sadness, for I shall miss him more than I dare think—the gardens there will never be the same again, never be so *"interesting,"* as he was so fond of saying.

ANNUAL REPORTS

Report of Secretary

April 18, 1932

BALANCE SHEET

Cash in bank	$ 36.35
Treasurer	377.65
	$ 414.00

LIABILITIES

B. F. Floyd	$ 414.00

STATEMENT OF OPERATIONS

Annual Memberships 1931	$ 650.00
Annual Memberships 1932	40.00
Sale of Proceedings	26.00
3 Perennial Memberships	30.00
1 Life Membership	25.00
	$ 771.00

Expenses 29 items	797.59
Deficit for year	$ 26.59

CASH RECEIPTS

Balance 4-8-31	$ 62.94
Receipts (See operating statements)	771.00
	$ 833.94

DISBURSEMENTS

Expense (See operating statements)	$ 797.59
	$ 797.59
In Bank	36.35
	$ 833.94

Report of Treasurer*

April 21, 1932

RECEIPTS

Balance carried forward from 1930	$ 331.03
151 Annual Memberships	302.00
6 Perennial Memberships	85.00
2 Proceedings sold outside	4.00
Received from interest on endowment	59.30
Received from advertising	254.20
Reconciliation from last year's report, items I had at the time—	
Advertising	70.00
Adjustment with endowment fund	25.69
	$1,131.22

DISBURSEMENTS

Printing for Treasurer's office	$ 24.75
One-half of cost of Rose-show at Miami last year	38.50
Treasurer's bond	12.50
Printing for Secretary's office	84.00
Office expenses	65.00
Paid on account of publishing of Proceedings E. O. Painter Printing Co. $150 was paid from Secretary's office direct, leaving a balance still due printer of $260.02.	900.00
	$1,124.75
Cash on hand for last season, not including receipts received for 32 memberships	$ 6.47

*There has been no change in the Endowment Fund since the last report.

Report of Auditing Committee

Your Auditing Committee went over both these reports (Secretary's and Treasurer's) and checked them carefully against the vouchers and bank accounts, and found them correct, and have so noted on the bottom of each statement in writing.

A. S. BEYMER,
F. M. O'BYRNE,
Committee.

Report of Executive Committee

February 25, 1932

A meeting of the Executive Committee was held at Davenport on the evening of February 25, 1932. There were present Messrs. Hume, Reasoner, Taylor, Drew and Floyd, with Mr. and Mrs. S. F. Poole as visitors. April 19, 20 and 21 were selected as the dates for the 45th Annual Meeting of the Society. Various phases of the proposed program were discussed in detail. The finances of the Society were reviewed by the Secretary and Treasurer for the information of the Committee. The Committee approved the action of the Secretary in proceeding with the printing of the Proceedings of the 1931 meetings. There being no further business the Committee adjourned to meet on call.

Report of Florida Agricultural Legislative Committee

Marvin Walker, Chairman, Tampa

I haven't a written report, and this verbal report will be very brief.

Last May there was held at Tampa a meeting of the Executive Committee and the Legislative Committee of this Society. The meeting was held to consider a situation then existing at Tallahassee, in regard to agricultural legislation. It was brought out at that time that the agricultural interests of this State are sorely lacking in proper or effective representation at Tallahassee, and several other places where their interests need to be properly looked after.

Those two committees of this Society, the Executive Committee and the Legislative Committee, authorized the appointment of another special committee to consider a plan for the establishment in Florida of an organization similar to that which they have in California. In California, they have what is known as the California Legislative Committee, which looks after the interests of the farmers of that State in Agricultural Legislation and Governmental Regulation matters. Our committee during the past year has made a very thorough study of the California way of looking after her farmers' interests, and matters of this kind; it has also gone to some of the important farm organizations and discussed the matter with them and obtained their reactions. I might say that the committee consists of Mr. J. A. Griffin, of the Exchange National Bank, Tampa; C. W. Lyons, of Tampa; R. B. Woolfolk, of Orlando; C. C. Commander, of Tampa; C. I. Brooks, of Miami, one of the Vice-Presidents of this Society; H. L. Robinson, Hastings; C. A. Simpson, Monticello, and your speaker.

The committee found that there was a unanimous agreement as to the need for an organization such as we contemplate in the State of Florida. The committee also felt that due to the

unusual economic conditions existing in the State this year, and due to the fact that our Legislature was not in session this year, that there was no need for an immediate organization here. It is ready, however, to proceed during the coming year with a plan which will bring all of its various organized agricultural interests together in one body, which will be able to effectively represent us at Tallahassee and at Washington.

All that the committee can ask in this report, Mr. President, is a continuance of authority to proceed with this matter during the coming year.

Motion made by L. B. Skinner, seconded by S. F. Poole, that the Committee be continued, and authority extended them to act.

Unanimously carried.

Report of Final Resolutions Committee

Whereas, the members of the Florida State Horticultural Society in 45th annual meeting, in Gainesville, have thoroughly enjoyed this further opportunity to partake of the hospitality and renew the associations with the various members of the state and college groups having headquarters here, and to enjoy the extensive, well prepared program of papers and discussions along with much pleasant entertainment, and

Whereas, the Society desires to express its appreciation to those responsible for this exceptionally successful gathering, and in particular—

To Dr. J. J. Tigert, President of the University of Florida and his staff who have made available the meeting place and assisted us in many things in a most gracious manner;

To Dr. Wilmon Newell, Director of the State Experiment Station and his associates, who have contributed much to the success of our meetings;

To Mr. Philip Thomas, Manager of the Hotel Thomas, for courteous attention to the wants of our members, and the excellent facilities made available to us during our sojourn in Gainesville;

To Mrs. B. V. Christensen, President, and the members of the Gainesville Garden Clubs, who assisted Mrs. M. M. Parrish with the most delightful tea, held in her beautiful home and garden;

To Dr. H. H. Hume, Chairman of Ornamental Plant Section, who contributed largely to the success of the Society's meetings;

To Mrs. Chas. W. Ten Eyck, President Florida Federation of Garden Clubs, who assisted in carrying out the program of the Ornamental Plant Section;

To J. Lee Smith and George A. Merrin for valuable assistance in the registration of our members, and

To the citizens of Gainesville for the many courtesies accorded our membership during our stay;

To Dr. T. Van Hyning, Director, Florida State Museum, for entertainment at the Museum during the reception held on the afternoon of April 21st;

To the newspapers of Gainesville, and elsewhere throughout Florida, who have given liberally of their space to give advance notice and reports relating to this meeting being held by the Florida Horticultural Society.

Therefore, Be It Resolved, by the Florida State Horticultural Society, in annual meeting assembled at Gainesville, this 21st day of April, 1932, that we express our appreciation to these many persons and agencies for the facilities provided and for the courtesies extended, in making our meeting so successful and pleasant.

DR. T. G. LEE,
FOREST BANNING,
Committee.

Election of Offiecrs for 1933

The Nominating Committee placed in nomination the following for Officers of the Society for the year 1933:

President—John S. Taylor, Largo.

Vice-Presidents—S. F. Poole, Lake Alfred; C. I. Brooks, Miami; C. W. Lyons, Tampa.

Secretary—Bayard F. Floyd, Davenport.

Treasurer—Norman Reasoner, Oneco.

Executive Committee—W. L. Drew, Eagle Lake; H. Harold Hume, Gainesville; Forrest D. Banning, Miami.

There being no nominations from the floor, a vote was taken that resulted in the unanimous election of each of the officers named above.

Selection of Meeting Place for 1933

The Society has received two invitations for its next annual meeting, viz: From the cities of Lake Wales, represented by F. M. O'Byrne, and Leesburg, represented by R. P. Burton.

Both of these cities are entirely eligible and deserving, and we can only recommend that it be put to a vote and that city reeceiving the most votes from those members present, be the next place of meeting.

MAX WALDRON,
R. L. BRYAN,
MR. COMPTON,
Committee.

By rising vote, the City of Lake Wales was unanimously selected as the place for the 1933 meeting of the Society.

Pres. Taylor: I appreciate the confidence you have placed in me. I appreciate the honor, and I want you to know I stand ready at any time I can to promote the growth and influence of this Society. We need more members—more active members, working members, and I hope every member here will make it their business to get one, two, three or half a dozen, or as many more members as possible to send their membership in to the Secretary. They will receive the book carrying all the proceedings of this meeting.

Dr. Camp said a while ago that he would be very glad to have as many of you as possible down to his juice plant where he is experimenting in frozen juices.

Motion was made, seconded and unanimously carried, to adjourn.

Meeting adjourned.

Thanks to Our Advertisers

To the Members of the Florida State Horticultural Society, and the advertisers who have favored us with their patronage:

THIS is the forty-fifth edition of the Florida State Horticultural Society Year Book.

For forty-four years the Society has issued this publication. The burden, of course, has fallen on the shoulders of a few. They have never murmured, but carried the load willingly and cheerfully, and take this opportunity of thanking those who have helped in the good work.

We are especially grateful to those who have contributed to the cost of getting out the publication by placing advertisements in the book. Without this help the publication of this year's Annual would have been almost impossible, and we think it is incumbent on the members of the Society to show their appreciation by patronizing those whose advertisements appear on the following pages.

THE FLORIDA STATE HORTICULTURAL SOCIETY

B. F. Floyd, Secretary — **Davenport, Florida**

N. A. Reasoner, Treasurer — **Oneco, Florida**

FOR forty-five consecutive years we have printed the Year Book of the Florida State Horticultural Society—this volume is the forty-fifth.

So far as we can remember, during all of these years there has never been a skip or a miss. Despite frosts, freezes, storms, drouths, insect pests, unsatisfactory marketing conditions—and many other things that would have disheartened and discouraged weaker and less stalwart men—the members of the Society saw to it that their annual publication was always forthcoming.

The burden of the publication has fallen on the shoulders of a few, and while every horticulturist in Florida is eligible for membership in the Society, the membership is less than one-tenth what it should be.

The development of the citrus industry in Florida can be credited largely to the Florida State Horticultural Society. Show your appreciation of the untiring and unselfish labors of those who have struggled for nearly half a century, by enrolling as members.

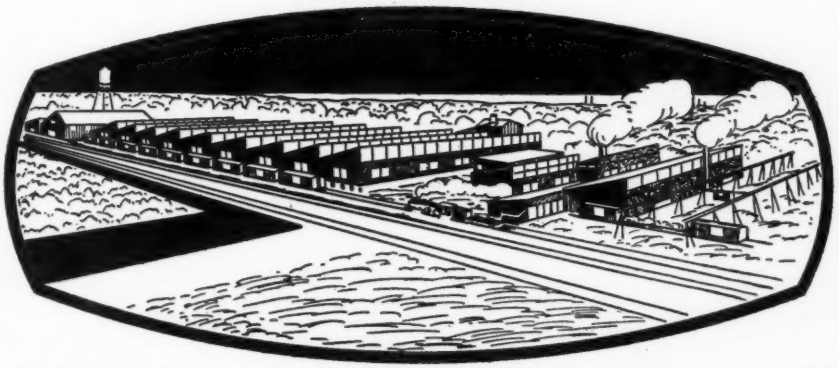
The E. O. Painter Printing Co.

DE LAND, FLORIDA

Florida Citrus Machinery Company

DIVISION FOOD MACHINERY CORPORATION

DUNEDIN, FLORIDA



More than twenty-five years' experience devoted exclusively to Florida citrus packing problems has enabled Skinner engineers to develop a line of machinery that meets Florida conditions especially well. That this is true is borne out by the fact that most of the houses in Florida are completely equipped with Skinner products. It makes little difference where you go, at home or abroad, Skinner machinery is standard equipment wherever fruit and vegetables are packed and canned in a commercial way.

More Money for the same Fruit Always

BROGDEX
REDUCES DECAY
RETARDS SHRINKAGE

Sound Delivery Fine Appearance Less Shrinkage

The Market Wants Brogdexed Fruit

The attitude of market buyers toward Florida fruit has undergone a marked change in the last few years. There used to be a very strong prejudice against our fruit. Some dealers would not handle it at all—claimed their decay and shrinkage losses more than ate up their profits. These dealers would admit, however, that Florida fruit was of better quality and contained more juice than competitive fruit and would be preferred except for its poor keeping qualities.

Brogdex has been gradually changing all of this. There are few dealers in any important market who do not now know of the protective qualities of Brogdex and buy this fruit in preference to the untreated kind.

As a result most Brogdex houses which formerly shipped to the auctions are now selling their output f.o.b. And in the auctions Brogdexed fruit is selling right along at a premium.

An analysis of the prices received for similar quality fruit in any terminal market will prove to anyone that more money for the same fruit simply means putting it through a Brogdex house—there is one near you.

FLORIDA BROGDEX DISTRIBUTORS

B. C. SKINNER, President **DUNEDIN, FLORIDA**

Here's the Fertilizer that will Deliver

"MOST VALUE PER DOLLAR"

to Your Crops

No matter how you sell your crops, the price they bring is the final test of their value. Crops in the market must stand on their own merit. By controlling the quality of your crops you are exercising the only control you have over them after they get to the markets.

The price your crops bring in these markets has a direct relation to the quality and amounts of fertilizer you use in growing them. Definite consideration is given this fact in the manufacture of Ideal Fertilizers. They are made scientifically and in accordance with result-proved formulas backed by the knowledge of more than thirty-nine years devoted to the study of proper fertilizing methods for Florida crops. That's why Ideal Fertilizers deliver **"Most Value Per Dollar"** to your crops.

IDEAL

Fertilizers

MANUFACTURED EXCLUSIVELY BY

Wilson & Toomer Fertilizer Company

Jacksonville Florida

GO AND SEE HOW TIME HAS PROVED A CLAIM

When some fertilizer authorities began to advocate all chemical mixtures a few years ago we answered: "Time will tell."

Now these same authorities have begun to admit that NACO Brand fertilizers containing organic nitrogen from Genuine HUMBOLDT Guano—Nature's Finest Fertilizer—have a vital influence in keeping groves in the pink of condition.

Groves fertilized with proper applications of recommended NACO formulas have produced profits year after year through the quality of the fruit, the size of the crop and improved condition of the trees. These NACO fertilized groves tell a convincing story to observant growers. Go and look at any NACO grove.

NITRATE AGENCIES COMPANY
1401-1407 LYNCH BUILDING
JACKSONVILLE - - FLORIDA

Play Safe--

FEED YOUR CROPS WITH

GULF BRANDS
of
FERTILIZER

"Cheaper in the long run"

THE GULF FERTILIZER CO.
Tampa, Florida

Beautify Your Home Grounds

Visit us at Oneco, or write for free advisory service. Over 45 years' experience is yours for the asking.

REASONER BROTHERS'

Royal Palm Nurseries
3233 Benedict Avenue
Oneco, Florida

Soil Improvement with LIME-

When necessary to neutralize an acid condition or where the soil is deficient in lime, its use is recommended.

The use of lime is not an expense for where it is used the fertilizer dollar goes farther.

Indiscriminate liming is not advisable. We prefer to make each application an individual case. Our laboratory is equipped with the latest type of electrical instruments for determining the pH of soil. For those interested in developing a liming program, we are glad to make tests and recommendations without charge.

Let us help you solve your liming problems.

DIXIE LIME PRODUCTS COMPANY

OCALA, FLORIDA

Ground Limestone LIMAN Hydrated Lime

WHAT FLORIDA MAKES — MAKES FLORIDA

MAGNETIC

SUPER - ADHESIVE DUSTING

LOOSE
AND
FREE FLOWING

BUT IS
FREE OF FILLER

ALL
KILLING POWER

SULPHUR

STOCKS
THROUGHOUT
FLORIDA

A
PROVEN PRODUCT

NATIONAL SULPHUR CO.

INC.

420 LEXINGTON AVE.
NEW YORK CITY

ELECTRIC

SUPER - ADHESIVE
DUSTING

SULPHUR

LOOSE AND FREE FLOWING | *FREE OF FILLER* | *100 LBS. KILLING POWER IN EVERY BAG*

SHIPMENT FROM STOCKS IN FLORIDA

STAUFFER CHEMICAL COMPANY

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SUITE 2118, GRAYBAR BLDG.
NEW YORK CITY

AGRICO

The Fertilizer with the EXTRA Plant Foods

FOR CITRUS use

AGRICO SEA FOWL or AGRICO BONE POTASH

THE BRANDS WHICH CUT PRODUCTION COSTS AND MAKE PROFITS

The American Agricultural Chemical Company

PIERCE, POLK COUNTY, FLORIDA

Citrus Growers

know that *through all the years* co-operative marketing has succeeded, has stabilized prices, has raised the price averages, has brought higher standards, has centered public attention on the product, has increased consumer demand through economical advertising and sales costs.

Any five, ten or twenty-year period study proves that it pays to "be steady" and "hold fast" to co-operative marketing.

FLORIDA CITRUS EXCHANGE

TAMPA, FLORIDA